PSYCHOLOGY IN EVERYDAY LIFE

The quality of the materials used in the manufacture of this book is governed by continued postwar shortages.

PSYCHOLOGY IN EVERYDAY LIFE

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PREFACE TO THE SECOND EDITION

AMERICA'S entry into the Second World War climaxed a period of tremendously accelerated change which has affected all the sciences as well as the fields of politics and economics and general human relationships. The author has tried in the first chapter to epitomize the impact of psychology upon what is now the daily life of millions of people. This chapter lays stress upon the existing activities of psychologists in a war-ridden world and attempts to suggest directions in which psychology can be of increasing service in leading us to a successful culmination of the struggle. Throughout the book illustrations and new factual material have been presented relating to this new world into which we have been plunged. All this has been aimed not only at making this book more practical than was the first edition, but also at stressing the fact that psychology itself has definitely left its cloistered laboratory, even as it earlier left its "armchair," and has moved into the great laboratory of life.

Some of the more important changes that have been made in the present edition include the addition of two entirely new chapters, the above-mentioned stress upon military psychology, and much new material covering suggestions for the solution of personal problems. A

glossary of technical terms has been added, as has a new listing of suggested readings. The presentation of the materials on physiological psychology has been placed in the Appendix, where they may be used for reference work or assigned as definite text work, at the discretion of the instructor. It is hoped that instructors will approve of the more systematic presentation of theories of personality and the attempt to deal with the currently vital problem of the development of adequate social attitudes. Altogether, more than one hundred pages of new material have been added, together with many new illustrations and tables.

The fundamental objectives of the book, as presented in the original preface, have not materially changed. It may be pointed out that the considerable number of texts stressing the practical side of psychology verifies the author's original judgment that psychology must "come down to earth." At the same time, the author would like to stress again the thought that being practical does not mean the presentation of spectacular or anecdotal material to the exclusion of the essential facts of the science.

The author expresses his appreciation of the many helpful criticisms and suggestions that have been tendered by his colleagues, both at Los Angeles City College and at other institutions. Mr. Keeler very kindly prepared the photographs showing the use of his polygraph especially for this text, and Dr. Gilliland permitted the reproduction of the illustrations from *Life* magazine covering the recent work on child testing at Northwestern University. Acknowledgment for per-

mission to use other illustrative material is indicated in the text. The author is indebted to Miss Petra Nievez for skillful assistance in this and other recent manuscript work.

WALTER C. VARNUM.

LOS ANGELES, CALIF.,
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PREFACE TO THE FIRST EDITION

THIS book is an attempt to meet an increasing demand for a textbook for nonprofessional students of psychology. Probably a vast majority of the students who take elementary psychology never go on to advanced work. This means that any benefit they may derive from their study of psychology must come from the content of this beginning course and from habits of reading that may be developed by it. With this fact in mind, the present book strives for two objectives. First, it seeks to stress the practical and nontechnical phases of the subject. It attempts to do this in a way that will motivate student interest and indicate the applications of the materials to the student's own personal life. In the second place, it has been kept in mind that this is a textbook and that a textbook should be a source of essential factual material. This information does not involve extensive technical references or descriptions, but it does involve condensed and simple statements of such facts as are most widely accepted and used in the subject.

The emphasis upon the practical phase of psychology has made necessary a somewhat arbitrary selection from among the more academic material usually included. It has seemed wisest in this connection to

eliminate the presentation of several conflicting theories where they exist. Thus, in the field of vision, the author has arbitrarily presented only the Ladd-Franklin theory. This has been done because it is a theory which is as widely accepted as any, because it is easy to understand, and particularly because it explains many interesting practical questions in the field of vision. No further apology is offered for the fact that the book does not deal with certain controversial materials or with detailed presentations of recent experimentation.

The adequate use of visual materials is implied in a psychology textbook that would practice what it preaches. In the present instance visual education techniques are carried out, not only by the illustrations within the book itself, but by the fact that the work has been prepared with a view to its being used in conjunction with classroom demonstrations. In the author's college one of the three hours of weekly class time is devoted to demonstrations. In these periods liberal use is made of motion pictures, lantern slides, and the demonstration of actual psychological experiments such as are suggested by the photographs in the text.

The writer has prepared a laboratory demonstration manual (VARNUM, W. C., *Measuring Your Abilities*, Gutenberg Press, Los Angeles, Calif., 1939), designed to accompany the present text. Care has been taken in preparing both the text and the manual so that either can be used independently of the other if desired. The manual will be found useful in simplifying the demonstration procedures, particularly if the instructor

contemplates using an actual psychological testing program. It is the writer's firm conviction that the beginning course in psychology should not merely tell how helpful psychological tests are but should demonstrate that helpfulness by giving students opportunity to come in contact with at least a certain number of them. The author's course offers the student, in addition to the regular laboratory demonstrations, the following battery of standard psychological tests.

1. A test of general intelligence.
2. A test of artistic aptitude.
3. A test of mechanical or other special aptitude.
4. A study-habits inventory.
5. An inventory dealing with personal adjustments.
6. An introversion-extroversion test.
7. A measure of social attitudes and social values.
8. A vocational-interest inventory.
9. A test of reading ability.

By the time a student has completed such a battery of tests and has been given the necessary psychological background for interpreting them, he should be able to approach his own problems of personal and vocational adjustment much more intelligently. It has been found also that a testing program is the most effective means of motivating a genuine interest in the subject.

The author wishes to express his appreciation for the cooperation and valuable criticism offered by his colleagues who have used the book in mimeographed form in their classes. He is indebted to Miss Margaret A. Young for suggestions and encouragement, as well as for aid in the actual preparation of the book. Thanks

are due Miss Sara Louise Steinau for her work on the manuscript. Acknowledgment to publishers and to authors for use of quotations or other materials is indicated in the text.

WALTER C. VARNUM.

LOS ANGELES, CALIF.,
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Chapter I

THE PSYCHOLOGIST IN WAR AND PEACE

THE task of the psychologist in both peace and war is the same. He must predict actions before they occur and discover capacities for action before the action is demanded. In wartime the psychologist may need to predict how people will act when a bomb falls or what a soldier is likely to do when confronted by the enemy under any given condition. He is asked to determine both the soldier's and the civilian's abilities so as to tell in advance who will make the best fighters in any given phase of military service or the most efficient workers in a defense plant. Far more attention has been paid to the task of predicting success in peacetime pursuits than in selecting men for military duty, although at the present time both the Army and the Navy are studying these problems. Let us consider one or two examples of successful work done by wartime psychologists.[1]

Donat found that by testing for attention, memory, and intelligence, he could predict with fair success the relative ability of men in handling antiaircraft artillery. The correlation of .77 between instructors' ranks and

[1] The following studies are reported in the special "Military Psychology" number of the *Psychological Bulletin*, June, 1941.

test achievement, which Donat found, is only five points higher than the correlation found by Harrell and Fobion between a pencil-and-paper test of spatial relations and success as airplane mechanics. German investigators found that the ability of men for duty as couriers could be predicted with an accuracy of .87 by a battery of tests made up of memory, quickness of apprehension, and power of observation. Some of the most important psychological studies relating to the war have been the attempts to predict marksmanship on the basis of steadiness tests. Spaeth and Dunham found a correlation of .61 between achievement on a steadiness test (a basic unit of psychological apparatus) and later actual scores on the target range. The American psychologist, Robert Seashore, working with Adams, also showed that steadiness could be used as a test that would differentiate between skilled and unskilled marksmen.

In modern warfare, which is a war of machines, success or failure may depend upon whether the men in charge of the machines have both ability and training in their use. The writer was visiting in Russia at the time of the outbreak of the Second World War and had some opportunity to observe the mobilization of that military machine. Later, when invasion of Russia was threatened, and everyone was asking himself whether or not Russia could be overrun with the same ease as had France, the writer stated that in his opinion Russia had actually developed the necessary military machine supported by an industry planned psychologically for efficiency with which to meet the German Blitzkrieg method. In

his opinion, the only question was whether the Russian military had been able to select from the great Russian masses those persons who had ability in machine operation and had then trained them. Subsequent events have proved that Russia, who is known among professional psychologists for her advancement in the field of psychology, had been able to choose and train operators of her war machines to the points where her army, though recruited partly from the ranks of peasants, presented a most brilliant defense against the Germans.

Psychological Testing in the American Military Service. Military psychology among the Allied powers, with the possible exception of Russia, has probably not reached the advanced point achieved by the German military machine. Indeed, it is to many a cause of great concern that our attempts at military modernization have not included a more realistic use of psychology in the selecting and placing of personnel. Some psychological work is, however, under way.

According to Lewis,[1] the present psychological testing routine of selective service men consists essentially of two parts:

1. The administration of a comprehensive test of 150 questions. This test is alleged to be a measure of one's quickness and accuracy in responding to orders rather than an attempt to measure the I.Q. as ordinarily defined. One suspects, however, that the objective is approximately the same as that sought in the old Army Alpha Test of the First World War. At any rate, the

[1] Lewis, W. M., "Vocational Implications of Selective Service," *School and College Placement*, Vol. 2, No. 1, p. 12.

men are classified into five groups on the basis of this test.

Class 1. Men of superior intelligence who will probably supply most of the commissioned-officer material to come from the ranks.

Class 2. Persons of good ability who may be expected to qualify for the better noncommissioned-officer ratings.

Class 3. Somewhat above average from whom future sergeants and corporals may be drawn.

Class 4. Average ability. "Basic soldier" material.

Class 5. Men of inferior mental ability.

This classification certainly constitutes an important first step in psychological work for the army.

2. The second part of the testing routine consists in a short trade information test to be used as a check on the alleged occupational skills as stated by the men in their questionnaire. In other words, when asked his main occupation, a man may answer carpenter whether he is capable of the most technical work in carpentry or home building, or whether he can merely handle a hammer and saw without fatally maiming himself! Such a typical checkup test may include 20 questions concerning a given trade. For instance, a carpenter may be asked what one uses to fasten the trunnians to the cope and drag? What is the name for the top and bottom part of a paneled door? To what does the term "ogee" apply? If a man answers 15 of the 20 questions correctly he may be assumed to be skilled in his trade. If between 10 and 15 questions are answered right he is listed as semiskilled, whereas if he answers less than half the

FIG. 1.—Measuring the psychological effects of oxygen deficiency. (*Public Relations Office, Randolph Field, Texas.*)

questions right he is not given a rating in that trade regardless of his own statements. On the basis of these two procedures the Army attempts to select that personnel which will be most efficient in filling each of the 290 types of specialist jobs which the Army lists. It is known that the general mental abilities test based on 150 questions works fairly well in segregating men of varying levels of intelligence. Psychologists would, on the other hand, have some qualms about determining one's trade ability on the basis of a mere 20 questions. These beginnings are, we may assume, being followed up by a more thoroughgoing program of psychological selection.

Selecting Leaders for the German Military Machine. The spectacular achievements of the German military machine during the first period of the Second World War raise many questions as to what psychological as well as industrial factors contributed to this success. Everyone seems to take for granted that the German military machine operates in conjunction with some mysterious superpsychological controls. In 1941 the Committee for National Morale published its survey entitled *German Psychological Warfare* under the editorship of L. Farago. This treatise gave American psychologists their first opportunity for studying the psychological factors operating in the German military. The implications of these findings are obviously of the highest importance in conjunction with our own efforts to expand and improve our military power. A point of major importance in this picture is the fact that the German military strength was developed during a time

when their army was limited by the Versailles Treaty to a mere token force of 100,000 men and their navy was reduced to 15,000 men. This fact made imperative the attack which Germany used, *viz.*, constituting of this army a nucleus of the highest possible type of leadership for the mass army that was to follow in a future war. The whole emphasis of German military psychology has been, therefore, upon the analysis of the traits essential for leadership and the devising of methods of selecting officers who possess these traits.

In the military service of our own and most other forces the emphasis seems to be just the reverse of the above. What little psychological testing work has been done has been concentrated in the areas of general intelligence and aptitude testing of the enlisted personnel with a view to segregating these men into the branches of work where they can operate most efficiently. Officer promotion, however, is determined largely by seniority and service record rather than by more objective evidences of capacity and training. As a specific instance of our meaning here, it is to be noted that in the German army no man can be promoted to the rank of general unless he possesses a doctor's degree in engineering, which is admittedly the most difficult advanced degree to obtain from the German educational system!

The German Concept of Leadership. Six traits are listed as constituting the specific requirements for a successful leader. These are:

1. Will Power. Will is stressed throughout the machine both for leaders and rank and file. It may be

noted that the Nazi idea of will is essentially what we might call "followership," that is to say, the habit of voluntary response to the command of the supreme leader. The importance of this for a dictatorship is at once clear but does not sound so strange to us who have often heard the expression, "before you can give orders you must know how to take them," which seems to have become more or less basic for personality evaluation in our own capitalistic industrial scheme.

2. Determination, which includes the ability to define a goal clearly and to devise means of attaining it.

3. Operative thinking, which incorporates both intellectuality and executive ability.

4. Mental Elasticity. This notion comes quite close to the correct psychological meaning of general intelligence, which we define as adaptibility through the capacity to form new habits and thus adjust one's line of action to meet new situations. German psychological strategists clearly recognized that the Blitzkrieg technique would involve rapidly changing and unpredictable alterations in plans, which would throw heavy responsibilities on the individual officers in the course of action.

5. Mathematical Thinking. The importance attached to this is indicated by the engineering-degree requirement for high officers noted above

6. Character. This rather subjective quality, which the Germans stress second only to the concept of Will, includes such concepts as integrity, idealism, and selflessness.

The importance of this last item of selflessness is stressed by the further analysis, which considers that

overestimation of one's own personality constitutes one of the two major pitfalls of leadership, since it makes for petty tyranny instead of engendering the "willful followership" defined above.

How Are German Military Leaders Selected?

Leader personality is recognized by the Germans as being a complex that cannot be analyzed easily and certainly cannot be measured objectively in its totality. American psychology would probably be forced to the same conclusion, although we should be inclined to place much heavier emphasis upon objective testing methods than have the Germans. The German view is that "technical skill must naturally be tested—but the prime requisite is the search for soldierly qualities which can be determined only through the study of the whole personality."[1] This "characterological" approach, as it is called, is followed through in a variety of ways.

1. It should be recognized that by the time a man becomes a candidate for an officership a very complete life (case) history is already available on him. He will probably have come up through the various Hitler youth groups, served in the storm troops, Black Corps, etc. A life history of this type is certainly of much greater realistic value than the type of case history that could be attained through a questionnaire, even if it were applied both to the candidate and to various of his acquaintances.

2. Performance Tests of Expressive Ability. Under this category the Germans include a variety of tests of

[1] LUBRICH, W., *Soldatentum*, 1937, pp. 138–142.

expressive function, some of which sound pretty much like pseudo-psychology to the American psychologically trained ear. Included are observations of body movements, voice quality, general physical appearance (neatness, robustness, physical strength, excitability), and an analysis of handwriting.

3. Mental-Capacity. By this term the Germans mean intelligence in pretty much the American sense, and, indeed, it is measured by intelligence tests that have been adopted directly from American psychology.

4. Action Analysis. This is a most basic part of officer selection and involves some laboratory testing of motor capacities but is based primarily upon actual field observations of the candidate. Two series of tests are run: (*a*) The command series involves the carrying out of orders covering an entire day's activity. Some of these activities place heavy strains upon the candidate's physical abilities, and many of them require high ability in quick thinking and memory. (*b*) The leadership test. The candidate is placed in charge of a group of soldiers and instructed to carry out some military problem such as setting up a bridge or the placing of barbed-wire entanglements, and his actual performance in such a leadership situation is carefully observed by the group of psychologists and the army leaders who are conducting the test. The testing program as outlined requires at least three days during which period the officer is under minute observation at all times.

It may be observed again that, although some parts of the testing program seem rather subjective, the whole thing certainly cannot be criticized for want of thorough-

ness, and, measured by its apparent results, it would seem to set a pretty good standard for the modernization of other military organizations.

Industrial Efficiency in Time of War

Industrial efficiency has its own economic justification in peacetime. In time of war it would seem to be almost criminally unpatriotic to fail to make use of any psychological devices that improve industrial efficiency. Modern warfare is a war of machines, not only on the battle front but in the production lines. The nation that can produce most efficiently and can adapt its production schedules to sudden new requirements will certainly enjoy a tremendous military advantage over an adversary that has made less intelligent use of industrial psychology.

Our consideration of psychology on the home front will be limited to two problems, *viz.*, problems relating to the selection and placing of workers and problems relating to rate of production. This latter in turn involves the consideration of time-and-motion studies and the setting up of a favorable working environment.

Psychological Testing in Personnel Work. Scientific personnel management must include not only tests of general intelligence and of special vocational abilities, but also a consideration of temperament and other personality factors that may be highly important for efficiency on the job. That tremendous economies can be effected through a testing program aimed at increasing the quality of employees and at a reduction in labor turnover is illustrated by the diagrams in Fig. 2,

presented by Wadsworth and covering his experiences in the public utility field.

Other examples of the way in which a scientific testing program can improve industrial efficiency as against the old pseudo-scientific personnel methods are to be found in the work of the Psychological Corporation, which was

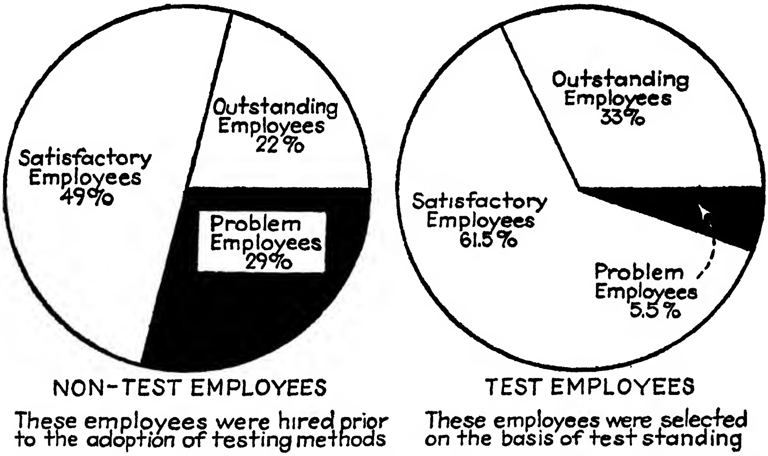


FIG. 2.—The results of using psychological tests in a business. (*From Wadsworth in The Personnel Journal.*)

able to eliminate 85 per cent of the untrainable men who were applying for work and thus eliminate the many tramp mechanics who had been running up the labor costs of the company concerned.

The high-pressure hiring program resulting from the expansion of defense program industries during the Second World War has raised enormous problems relating to personnel selection. Despite this fact the great Lockheed Aircraft Corporation, which installed a scientific testing program at about the time of the opening of hostilities, was able to increase its percentage

of successful hirings from 6 out of 10 to an average of 9½ out of 10. The importance of such economies in terms of our war effort can scarcely be overestimated. The outstanding work of the Lockheed Aircraft Corporation is particularly significant in view of the fact that other large defense corporations have, as in the last war, fallen victim to pseudo-scientific personnel systems based on physiognomy tests. The psychologist, along with the general public, may feel that during normal times a company may be considered as "fair game" for the pseudo-personnel man, but he feels a sense of righteous indignation when these untrained opportunists stand in the way of improved industrial efficiency during times of national crisis.

In a later chapter a more detailed study will be made of the various tests of general intelligence and special abilities upon which modern personnel work is based.

Industrial Psychology. With the great care and engineering skill that have been expended in designing and operating the machinery of our modern age has gone an almost complete absence of attention to the human factor. People have drifted into various lines of work on a purely chance basis. The correctness of the *human* design for a given task has been given scarcely a thought. If the next age is to be one of *human engineering*, psychology must make it possible for the guidance and selection of men on the job to be handled on the same scientific basis which has long been applied to the machines they worked. Having selected the workers best suited to the job, the next task of the psychologist becomes that of establishing working conditions making

for the greatest efficiency. A few phases of this work will be dealt with in following sections.

The Relation of Muscle Tonus to Personal and Industrial Efficiency. Research has shown that muscle fibers contract according to the all-or-none principle. This means that, if a given fiber contracts at all, it will contract to its full force. Differences in the pulling force of a given muscle group will depend therefore on the number of fibers active at a given moment. This fact enables us to understand the important phenomenon of muscle tonus. Let us assume that a given muscle group is made up of 1,000 individual fibers. The maximum pulling power of this muscle would result when all 1,000 fibers were active at the same time, which is a situation that almost never occurs. Perhaps the simultaneous action of 800 fibers would produce what would appear to be a very powerful muscular effort. If, instead of 800, only 200 were active the effect might be to move the part of the body in a way that would be just barely observable. This point is called the "threshold" of action. If fewer than the threshold number of fibers is active, no visible movement will result, although the few individual fibers will be pulling each with its maximum individual force.

Sub-threshold responses give rise to what is called tonus. The tonus of a muscle determines its readiness to respond. No healthy muscle is ever completely relaxed or flaccid. Where complete flaccidity occurs owing to nerve or other injury, as in the case of infantile paralysis, the muscle undergoes what is called atrophy through disuse and gradually wastes away. In

our example, where the muscle is apparently relaxed, we might find that only 40 or 50 fibers were active. In this condition the muscle would show considerable sluggishness in reaching the threshold of action. In Fig. 3 one can see that the nearer the degree of tonus approaches the threshold the easier it will be for the

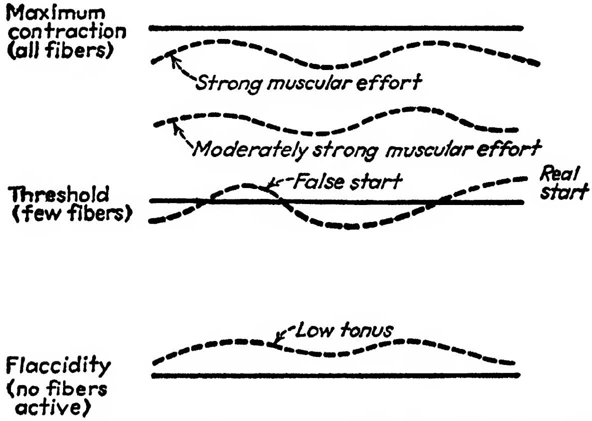


FIG. 3.—All-or-none principle, tonus, and degrees of muscular effort.

muscle to begin overt action. The sprinter on the mark strives to keep his running muscles just as near the threshold as possible so that when the starting gun is fired he can make a rapid start. If his nerve and muscle control is not good, he may involuntarily slip over the threshold, in which case we have a "false start."

Not only is the state of muscle tonus important in determining our efficiency in beginning action of various kinds, but it also explains much of what we call attention. If one is ready to respond to certain stimuli (*i.e.*, his tonus is high), he will respond to them where otherwise he might not. The important subject of attitudes

is also closely related to this question of muscular tonus. The attitude of patriotism involves a fairly continuous state of readiness to respond to such stimuli as the flag, the national anthem, or marching soldiers.

Tonus is also closely related to problems of nervous exhaustion. It has been shown by Jacobson and others that nervousness involves holding large groups of muscles almost at the threshold point when there is no need of their being so keyed up. This explains why nervous people are so tense and jumpy. This constant sub-threshold activity uses up energy in exactly the same way as does overt action except that the rate of fatigue is slower. When a person keeps himself keyed up in this partial fashion all day long and even to some extent at night, as is the case with insomnia sufferers, it is no wonder he suffers from nervous exhaustion.

Fatigue and Efficiency of Work. Our interest in muscle action goes much beyond an interest in the way an isolated muscle functions. In psychology we are interested rather in the way in which muscles work together in an integrated organism. The study of muscles under controlled conditions is called "ergography." The Mosso ergograph is used to study the muscular work performed by the fingers. If the finger be required to lift a 5-kilogram weight once every 2 seconds, it will be found that, though the finger can lift the weight to a full height at first, it rapidly loses its ability to do this, with the result that successive contractions become shorter and shorter. When the muscles of the finger have become completely exhausted in this way, it is still possible to obtain work from them by reducing the weight to be lifted. Thus, if

the 5-kilogram weight be reduced to 2 or 3 kilograms, it will be found that the apparently fatigued muscle can again lift to its maximum height. The muscle will, however, fatigue in this second case much more quickly than it did in the first instance. Studies have shown that muscles which are worked to the point of complete fatigue recover very slowly, whereas if a muscle is exercised to the point of only 50 per cent fatigue, the recovery will be much more rapid.

The original work on this subject was that by Mosso, in which he demonstrated the great importance of allowing a rest period before complete fatigue sets in. Figure 4 shows the relation between the number of lifts on the ergograph and the per cent of fatigue as measured by the length of time required for recovery. Thirty lifts resulted in complete exhaustion requiring 2 hours for recovery; 15 lifts involved only 25 per cent fatigue since only ½ hour was required for recovery. From the chart it will be seen that the last 3 lifts caused as much fatigue as did the first 15. The principle of efficiency which has grown out of this study and which is constantly applied in industrial studies is "Keep muscles working in the early part of the fatigue curve." This means, of course, more frequent rests. The interesting point is that these increases in the number of rest periods almost invariably result in a greater rate of production for the workers and at the same time leave them less exhausted at the close of the day.

These simple principles of efficiency in muscle action have been applied in the study of industrial efficiency. Gilbreth was able to increase the number of bricks that

a workman could place per hour from 120 to 350. This tremendous increase in production was accomplished not only by reducing the energy expended by the men, but by actually reducing the total time the men were working. Thus, though the men worked a shorter num-

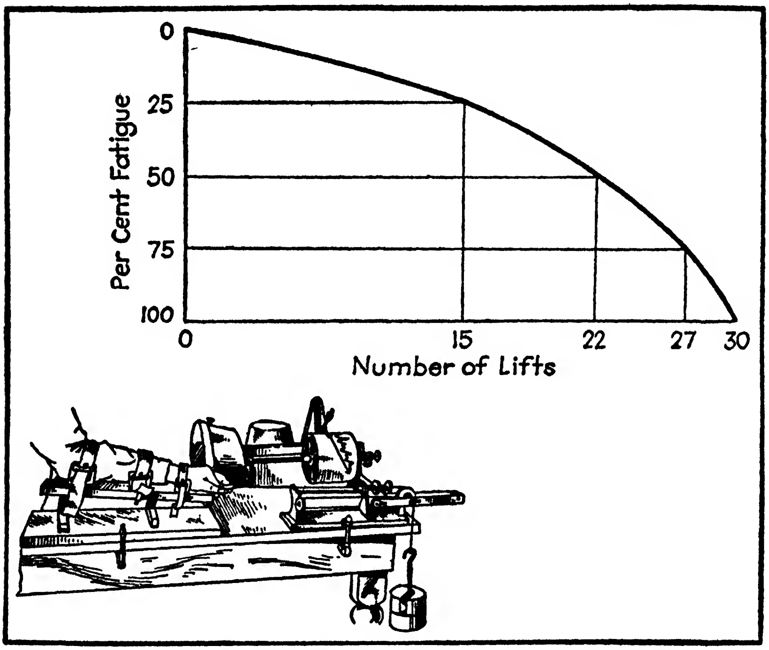


FIG. 4.—Fatigue curves as measured by the ergograph. (*From Mosso after Poffenberger.*)

ber of hours in the second case, they were able to produce more than twice the amount of work. Again, in work of lighter nature, it has been found that properly spacing the rest periods can increase production. Thus, with girls folding handkerchiefs, it has been found that if the girls will work 5 minutes and then rest 1 minute, and then work 5 minutes more and rest, that such an

interrupted work program makes possible a tripling of the output. The reason for these remarkable improvements lies in the nature of muscle work. Each muscle has its own optimum strength, its optimum rate of work, and its optimum period of duration of effort. Thus, the muscle of the finger can be fatigued in 3 to 5 minutes, as we have shown, if it is lifting a 5-kilogram weight once every 2 seconds. If, however, it lifts a 1-kilogram weight every 10 seconds, the muscle is shown to be practically indefatigable. Among the most important functions of psychology have been its studies of the conditions of more efficient work.

Individual Differences. Differences in capacity for work show themselves even more clearly in industry than in other phases of life. Perhaps this is because there are more likely to be accurate quantitative methods of determining output. The following cases are chosen from among many industrial studies showing individual differences. In a shoe factory, output in one operation varied from 490 to 245 pairs per day. In another operation it ranged from 210 to 130 pairs per day. The earnings of the drivers for a large taxi company showed the following variation:

40 best averaged: $1,626.74
40 poorest averaged: $1,069.91

These men were all using the same rather expensive equipment and all used the same streets, yet the good drivers produced over 50 per cent more than the poor ones.

In addition to differences due to the individuals, there are vast differences in output related to the way work is

planned, to environmental conditions, and to certain psychiatric considerations.

Time-and-motion Studies. In this field the work of the Gilbreths is outstanding. One of their early studies was on bricklaying. By means of photography they were able to chart the apparently routine task of bricklaying and to show that, although only 6 movements were needed, most workers were actually using 15. When the more efficient method was applied the workers found themselves laying three times as many bricks with no greater effort than they had used before. In another study of men loading pig iron into boxcars, Taylor was able to plan the movements and establish rest periods in such a way that the men loaded 47½ tons per day apiece instead of 12½ as before. Table 1 shows the results of another of Taylor's studies in improving industrial efficiency.

TABLE 1

Improvements in Efficiency under Scientific Management

(From Taylor)

The number of yard laborers was reduced from between..........	400 and 600 to about	140
Average number of tons per man per day increased from.............	16 to	59
Average earnings per man per day increased from.................	$1.15 to	$1.88
Average cost of handling a ton of 2,240 pounds decreased from....	$0.072 to	$0.033

During this year the total saving of the new plan over the old amounted to $36,417.69, and, during the six months following, when all the work of the yard was on task work, the saving was at the rate of between $75,000 and $80,000 per year.

Working Conditions: Lighting. The physical environment affects efficiency in industrial work just as it does

in one's personal life. Two factors, light and ventilation, will be considered here.

An early study in England showed (Fig. 5) that output fell off greatly during the hours in which artificial light was required and that this influence affected the

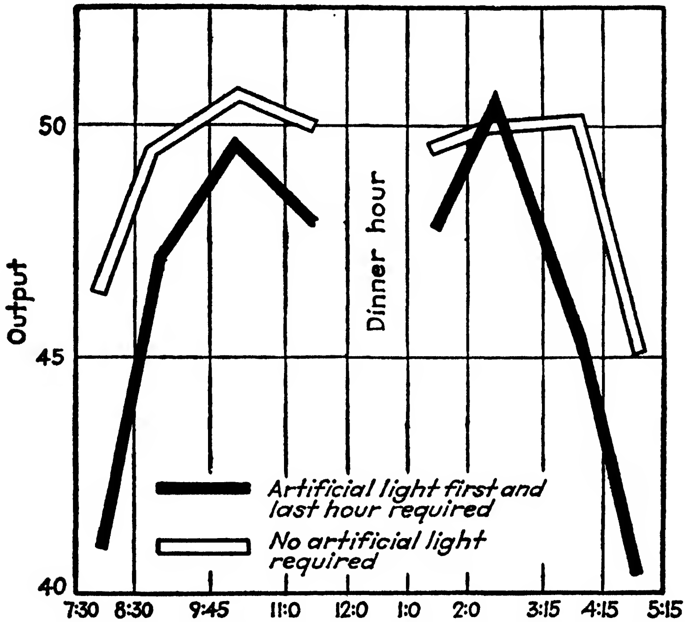


FIG. 5.—The influence of poor illumination upon output. (*From Poffenberger.*)

whole day's output as compared to output on the days when no artificial light was needed. Sunlight, properly used, is always superior to artificial light.

Where artificial light must be used, certain basic principles can be applied to assure its use in the most efficient manner possible. One of the most important superiorities of sunlight is its uniformity rather than its intensity. The human eye can easily adapt itself to large differences in intensity of light, but fatigue results when

the eye must constantly adjust to differences in intensity. The correct measure for the quality of lighting is the amount of work which can be produced under it and not how small an object can be seen.

Feree and Rand showed that where indirect lighting is used there is almost no difference in efficiency between

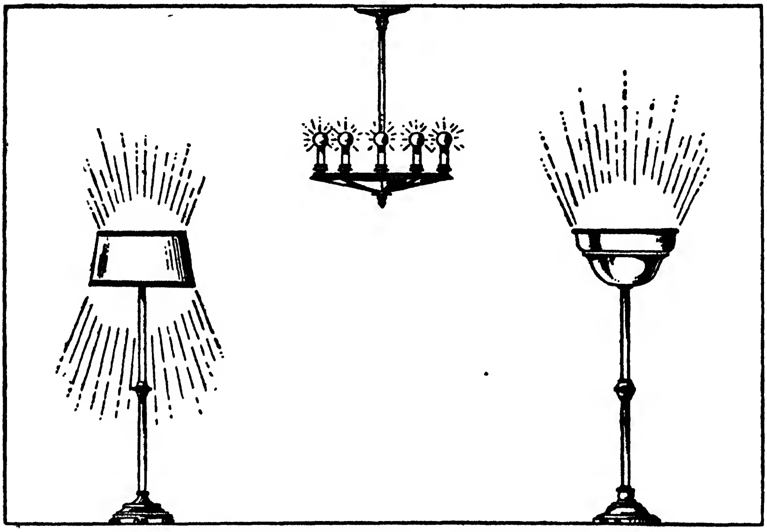


FIG. 6.—Semidirect, direct, and indirect lighting.

an intensity of 1.33 and 5.2 foot-candles. Where direct lighting was used the higher intensities were more fatiguing than either an intermediate or a low intensity.

The comparatively higher cost of maintaining needlessly intense illumination was shown by Rice who studied the increase in meter candles required to obtain daylight acuity:

¼ daylight acuity is obtained with about ⅛ candle meter
½ daylight acuity is obtained with about 1 candle meter
¾ daylight acuity is obtained with about 8 candle meter
1 daylight acuity is obtained with about 50 candle meter

Working Conditions: Ventilation. America is being made "air-conditioning conscious." What are the essential facts as to the relation of ventilation to human efficiency? As is the case with lighting, the facts are simple, although correct ventilation cannot be achieved so cheaply and easily as can correct lighting.

First of all we may note that the question of the oxygen content of the air is a secondary matter as related to our problem.[1] It has been shown the normal percentage (19+) of oxygen in the air must fall to about 13 per cent before there is any noticeable result on human efficiency. Even in the most undesirable factory conditions, the percentage almost never goes below 16! The two factors that do affect efficiency are temperature and humidity. Repeated experiments have shown that accuracy in mental work and output in physical work fall off rapidly as the temperature rises. One study shows that 60 per cent more errors are made with a temperature of 90°F. than when it is normal.

It is generally agreed that the ideal temperature is 68°F., yet how few of us take any pains to see if our room temperatures are kept at least in the neighborhood of 70°F.?

The relation of humidity to ventilation is twofold. As the temperature of air rises, its relative humidity falls. This means that, unless treated, all artificially heated air will be excessively dry. This dryness causes

[1] The question of oxygen deficiency is, of course, a critical one as related to flying, especially in the work of military pilots. Both the Army and the Navy have set up psychological research centers to investigate these and related problems. See Fig. 1 and the Valentine reference at end of this chapter.

irritation and is probably a predisposing cause of colds. When hot air contains too much moisture, as on "muggy" days, the effect is the same as a still further increase in temperature. This is because the high relative humidity retards the evaporation of perspiration upon which the body depends for cooling. Keeping the air circulating gently will very largely counteract this condition in most cases. The simple expedient of opening a couple of windows will usually provide adequate control of ventilation. It will result in a lowered temperature and it will permit the air to circulate so that the natural cooling processes may go on even though the outside temperature be above 70°F.

Working Conditions: Clothing. Probably as serious in its debilitating effects as general room temperature is the artificially high temperature which most of us maintain at our skin surfaces through the clothing we wear. Just as most of us work in rooms that are entirely too warm, so most of us wear entirely too much and too tight-fitting clothing. Women's clothing, which used to bear the brunt of the hygienist's wrath, has in recent years changed, until today it is in general far more healthful than men's. Considerations of personal efficiency demand a definite trend toward lighter and looser fitting men's clothes. In cold weather it is far better to wear a heavy overcoat, scarf, and gloves which can be removed on coming indoors, than to wear heavy underclothing and tight-fitting suits which prevent the air from circulating to the skin.

An encouraging example of dress reform is that of the revision of the U. S. Army uniform. The elimination of

the old choke collar and the spiral puttee ended two basic sources of discomfort. The spiral puttee was especially bad in that it bound the calf of the leg to the point of causing cramps—not to mention its tendency to fall down at critical moments. The new military trousers are dressy, afford better ventilation and may be adapted to campaign duty by adding the new legging, which "stays put" but does not cramp the leg muscles.

Psychiatric Considerations

The activities of industrial psychologists have often been opposed by workers on the ground that they resulted merely in a "speed up" without corresponding benefit to the workers. In one case output in a laundry was increased 30 per cent by having the feeder and receiver alternate tasks every 12 minutes. If none of this 30 per cent increase is distributed to the workers, we cannot be surprised if they show lack of enthusiasm for psychological methods. In munition plants during the First World War, it was found that the total output was 19 per cent greater when workers were put on a 55.5 hour week than when they worked 66.7 hours per week. If, as has too often happened, the men's wages were lowered in proportion to their shortened hours one need not be surprised at their resentment.

The results of increased efficiency must be shared with the workers. Until this principle is put into practice by employers, we can expect only limited and unsatisfactory results from our industrial psychology. In this connection Laird has coined the happy phrase "mental wages" to refer to the contribution which psychology

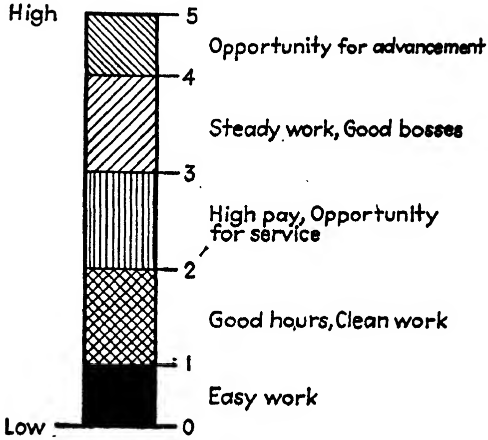
can make to the welfare of the workers. Worker interest does not depend primarily upon easy work or even high pay, as a recent survey shows. What workers do most desire is security on the job and an opportunity for advancement.

TABLE 2

What Makes a Job Interesting

Based on 100 department-store employees.

(From Laird)



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Chapter 2

SCIENTIFIC VERSUS PSEUDO-PSYCHOLOGY

THE reaction hypothesis is the psychological application of the law of causation. Just as we say in the field of science as a whole that there can be no effect without a preceding cause, so we say in psychology that *there can be no response or activity without a stimulus to set it off*. Professor Woodworth has somewhat facetiously stated that over the door of every psychology laboratory should be placed a large bronze tablet bearing the symbol *S-R* (stimulus-response). By this illustration he meant to emphasize the importance of the reaction hypothesis for all psychologists. It is particularly important that the beginning student should learn to think of both human and animal behavior as resulting from the operation of definite forces upon the organism. These forces, which consist in either internal or external energy changes, are what the psychologist calls "stimuli." The action which the animal carries out in adjusting himself to these changes constitutes what the psychologist calls the "response." All the complicated psychological mechanisms which we shall study will be related to receiving stimuli, communicating them by means of the nervous system through the body, and translating them into action through the use of muscles and glands.

The mechanism by which these responses are carried out is represented in simplified diagrammatic form in Fig. 7. It will be seen from this diagram that even the simplest possible stimulus response arc involves at least two neurons; an afferent or sensory neuron leads from the sense organ to the spinal cord and there connects by means of a synaptic connection to an efferent or motor nerve, which leads to the muscle or gland that carries

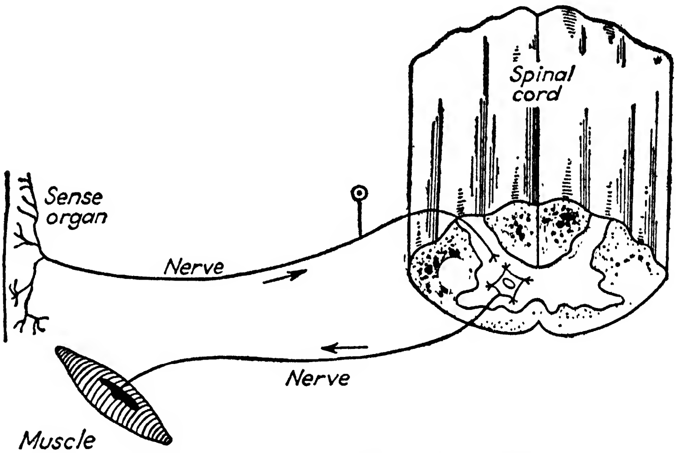


FIG. 7.—A simple stimulus-response circuit.

out the response. The student will understand that this diagram is greatly oversimplified. It should be particularly noted that in addition to the motor nerve shown there are actually many hundreds of other similar motor nerves to which the impulse could pass from any given sensory nerve. Our ability to respond in different ways at various times to the same stimulus is sometimes explained by the fact that the impulse may pass now over one motor nerve and later over another. Actions that are related to these simple nerve circuits are called

reflexes. It is believed by many that learning consists in the grouping together of numbers of these simple circuits into more complex patterns. These complex patterns result in the performance of our everyday activities of walking, talking, driving cars, etc. A much more detailed study of the structure and function of our nervous system together with a statement of the views regarding its function is to be found in the Appendix at the end of this book and may be read by the student desirous of obtaining a more complete understanding of the operation of our nervous system.

Reaction-time Experiment

One of the earliest experiments using instruments of precision in measurement was the reaction-time experiment, which is used to determine the length of time required for the carrying out of a stimulus-response activity. Since simple stimulus-response activities constitute the basis of all psychological activity, we may consider the reaction-time experiment to be the fundamental experiment in psychology. It is fundamental also because it illustrates so well the manner in which the scientific method is applied to psychological problems.

Interest in reaction time dates back to 1796, in which year astronomical observers in Greenwich, England, discovered that different people read through a telescope the instant of the passage of stars across the meridian differently. It was first thought that this resulted from the fact that some observers were careless. It soon became clear, however, that the error resulted from the fact that it took some persons longer to react to

the stimulus of the crossing star than it did others. In order to attack this problem of individual reaction time, it became necessary to develop very accurate timing instruments. "Chronoscopes," as these instruments are called, measure time to as small an interval as 1/1000 second.

In measuring a "simple reaction" the experimenter gives the subject a "ready signal" and then presses a telegraph key. This key flashes a light signal or sounds a bell and also starts the chronoscope. The instant the subject sees the light or hears the sound he responds by pressing a second telegraph key. This stops the chronoscope. The interval measured is the length of time from the flash of the light to the muscular movement of pressing the key. Such an action, which would seem to be as "quick as a wink," and indeed is almost as quick, not only can be measured with great accuracy but has been shown to require considerable differences in time for its performances among various subjects. The process involved in a simple reaction is actually not so simple when one considers what has to take place. In the case of a response to a light stimulation, the light must first enter the eye. Here a chemical reaction is set up in the retina of the eye which stimulates sensory nerves leading to the brain. From the brain the impulse must pass down the spinal cord and out along the arm to the muscles of the hand. Finally these muscles must contract so as to depress the telegraph key. When we learn that this whole process requires only $^{150}/_{1000}$ to $^{200}/_{1000}$ second, we may well wonder at the marvelous efficiency of the human system. Not only do individuals differ

from each other as to their reaction times, but different kinds of stimuli result in faster or slower reactions. The average reaction times for various kinds of sense organ stimulation are shown in Table 3 and presented graphically in Fig. 16.

There are a great number of other factors that contribute to the length of time required for carrying out simple actions. We shall mention here only the fact that as the mental process involved becomes more and

TABLE 3

Range of Reaction Time

TYPE OF STIMULATION	REACTION TIME, SECONDS
Tactual	0.110 to 0.160
Auditory	0.120 to 0.160
Visual	0.150 to 0.200
Olfactory	0.200 to 0.800
Gustatory	0.300 to 1.000
Pain	0.400 to 1.000

more complicated the reaction time becomes not only longer but less constant. A complete study of the history of the reaction-time experiment together with a statement of the reaction times under various conditions is to be found in Garrett's *Great Experiments in Psychology.* The following section relates this experiment to the practical problem of automobile driving.

Psychology and the Motorist

In 1933 Los Angeles and surrounding communities were the victims of one of the severest earthquakes that have rocked California. Over one hundred lives are known to have been lost. The tragedy reverberated over the entire United States and evoked special executive decrees from the President. And yet—tomorrow, Sun-

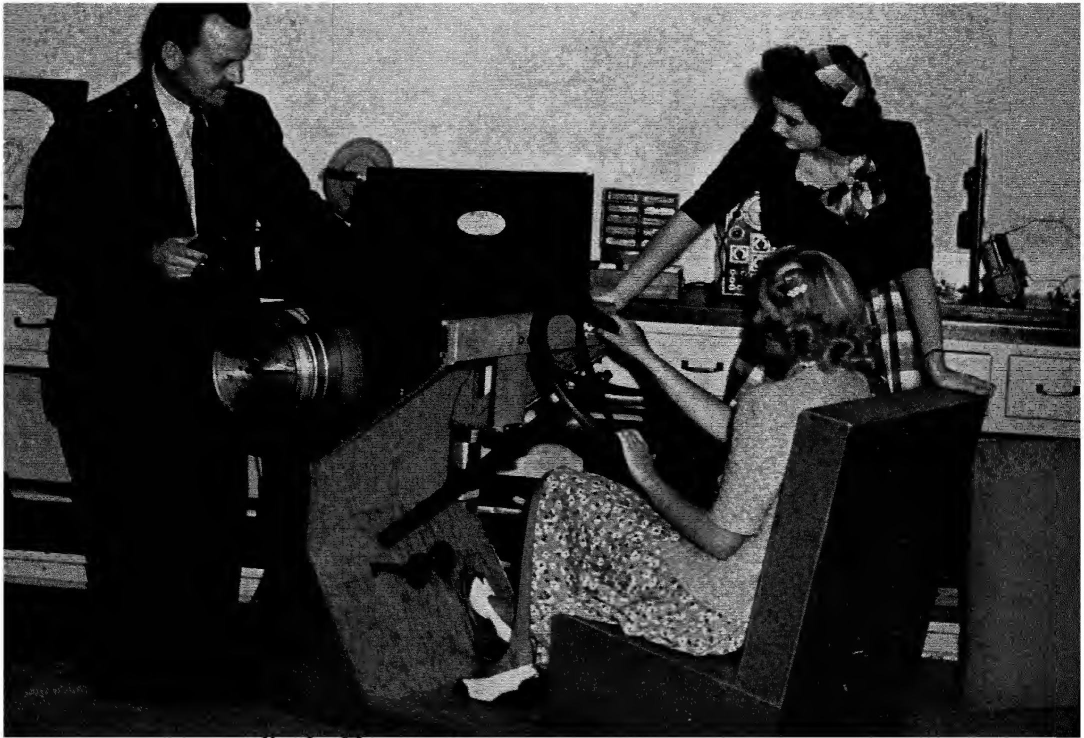


FIG. 8.—Measuring the reaction time of drivers.

(Facing page 32.)

day, and every Sunday thereafter, more than five hundred people will perish in the United States in automobile accidents. Every Sunday five times as many people fall victim to one phase of our motor transportation system as lost their lives in what will be considered as one of the major cataclysms of California history!

The magnitude of the toll of motoring could be illustrated by many analogies. The diagram below shows the

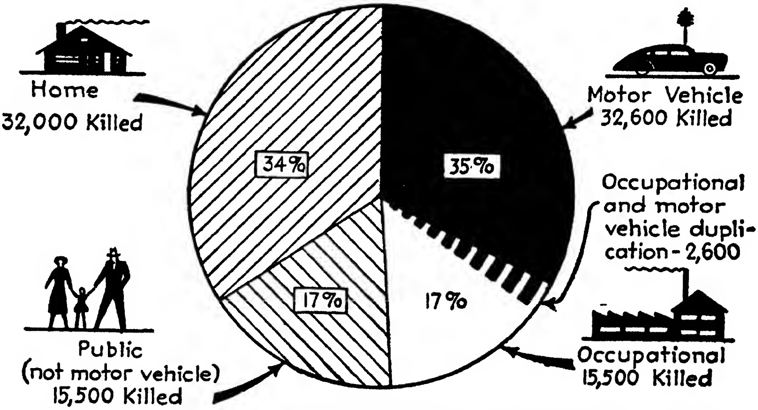


FIG. 9.—Principal classes of accidental deaths. (*Accident Facts*, 1940 *Ed.*)

importance of the automobile as a cause of death in comparison with other causes.

In studying automobile-accident statistics one sees quickly that individual differences are important here as elsewhere in psychological matters. For instance, the percentage of deaths among pedestrians is directly related to the age of the pedestrians. Figure 10 shows that very young children and very elderly persons are decidedly more likely to be victims of pedestrian accidents than are any other age groups. One may surmise that slowness in reaction time and poor coordination

may well account for the high accident rate among elderly people. This does not, however, account for it among children. One reasonable assumption is that their difficulty lies in the lack of proper training concerning

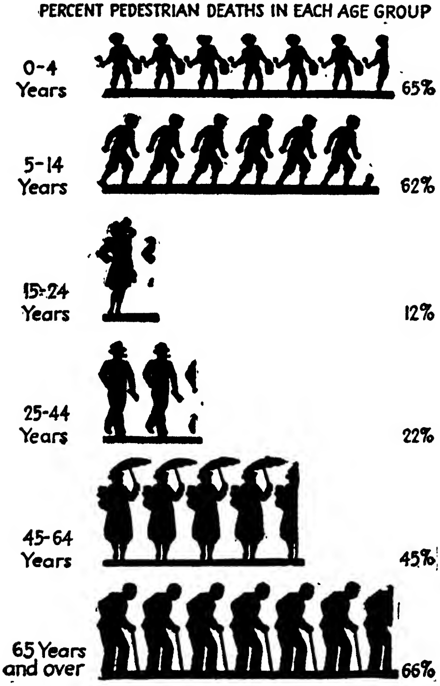


FIG. 10.—Frequency of pedestrian deaths at various ages. (*Courtesy of American Book Company.*)

the nature of automobile movements and the hazards associated with them. An interesting illustration of a way of attacking this important problem is to be found in the safety education work of F. C. Boals. In order to teach children to be better pedestrians they are lead to play the game of "safety," which consists in driving tiny toy automobiles as illustrated in Fig. 11. In the process

of driving these toy cars along "Child Town Streets," during which they obey traffic signals and boulevard stops and remain on the alert for pedestrians, they are lead to a familiarity with the automobile as an important part of our modern complex civilization. It is of special interest to notice that the problem here is not that of training safe drivers, but that of making safe pedestrians through a familiarity with automobiles. Such ingenious psychological approaches are important if we are to combat successfully the tragically high accident rate among our children.

Rapid progress has been made in recent years in eliminating the physical factors making for discomfort and danger in motoring. Unfortunately no comparable study has been devoted to the more complicated problem of the human factor. It is customary to say that only 10 per cent of our accidents result from mechanical defects, whereas 90 per cent are attributable to psychological failures of persons. Strictly speaking, this is true, although, as we shall see later, the individual may in turn be led to his failures through the failure of others to produce cars that are correctly designed from the standpoint of psychological function.

The problem of accidents on the highway is closely associated with industrial accidents in general. The tests to be discussed in this chapter show that proneness to accidents is a factor which can be isolated. Farmer and Chambers conducted a test in which a modification of McDougall's dotting machine was used. In this test the subject attempts to place dots in the centers of a series of small circles as they pass rapidly before him.

These investigators showed that in each of six groups those who fell below the average achievement on the dotting test had considerably greater accident rates than those who exceeded the average. The average for all groups showed an accident rate of 74 for those exceeding the average in the dotting test, and a rate of 125 for those falling below it! The authors properly conclude that accident proneness is, in an important degree, due to measurable individual differences.

Tests of Motormen. In a study of 200 experienced motormen, it was shown that one-fifth of the men were responsible for one-half of all the accidents of the entire group! In seeking criteria that might correlate with lower accident liability, Slocombe and Bingham settled upon "high coasting ability" as a criterion of skill in streetcar driving. An objective measure of the coasting ability was available since each car carried a clock which automatically recorded the number of minutes during each trip that neither electricity nor brakes were used. A high coasting record is encouraged by the company because it means a saving in both electricity and in wear on the brakes. In this study the 100 men with best coasting record and the 100 with the poorest record were selected and their accident rates for 9 months were compared. The results showed 364 accidents for the poor coasters as against 313 for the good coasters. A check on delinquencies in the service showed 73 delinquencies for the poor coasters and only 46 for the good. Here, as in several studies that will be mentioned, the most efficient and skilled workers were those with the lowest accident rates.

FIG. 11.—Tots learn safe pedestrian practices in model driving situations. (*Courtesy of Buick Magazine.*)

(*Facing page 36.*)

In continuing this same study, the authors sought for relationships between the physical condition of the motormen and their accident rates. The criterion used here was high blood pressure. Most transportation companies pension or transfer to other work those who show excessively high blood pressure so that the term high blood pressure as used here means simply abnormal blood pressure as compared to normal. Fifty-nine men over fifty years of age were examined. Of this number 21 had abnormal blood pressure. These 21 men had 136 accidents whereas the 38 men with normal blood pressure had only 110. This means that the former averaged more than twice as many accidents (6½ per man) as the latter (3 per man).

These facts indicate clearly that the liability to accident of a given driver may be at least roughly predicted on the basis of (1) certain types of motor capacity, especially reaction time and coordination of movements, and (2) certain physical conditions. Later in the chapter we shall see that the factor of emotional stability also demands consideration. Transportation companies have not been slow to realize the possibilities for important economies through the use of these scientific methods of selecting operators. We shall mention briefly two such programs.

In the city of Paris, France, J. M. Lahy undertook the scientific selection of the streetcar motormen and automobile bus drivers to be employed by the Société des Transports. The aptitude test used consisted of a battery of the following tests:

1. Muscular strength
2. Fatiguability
3. Motor suggestibility
4. Simple reaction time
5. Estimations of speed and distance
6. Emotional stability

Previous to the installation of the testing program, the Société had lost an average of 20 per cent of their new employees during the period of apprenticeship. Through the use of the tests, it was possible to reduce this by 3.4 per cent. This represented an annual saving of 150,000 francs. More important than the saving during the training period was the fact that consequent upon the application of these tests the accident rate for the company was reduced 16 per cent. This represented an annual saving in cash of 1,300,000 francs.

Studies of Taxicab Drivers. In the field of psychological tests for taxicab drivers, the work of A. J. Snow is outstanding. Most of this work has been done in cooperation with the Yellow Cab Company of Chicago, although other large concerns are now using the tests. Snow's test for taxicab drivers is a thorough examination made up of eight separate tests involving the use of an elaborate setup.

The examination, which has been administered to over 20,000 drivers in Chicago alone, is made up as follows:

SNOW'S TEST FOR TAXICAB DRIVERS

1. A complete physical examination
2. An intelligence test

3. Emotional stability
4. A recklessness test
5. Muscular fatigue
6. Muscular resistance
7. Reaction-time tests
8. Perception of space and motion

This battery of tests will be seen at once to be a complicated one, so much so as to render it costly as a test for the general driving public. Only further extensive research can tell whether a less thoroughgoing analysis can be depended on to isolate the poor driving risk from the comparatively safe drivers. It is certain at any rate that Snow's test has proved its practicability in selecting superior commercial vehicle operators.

As a result of this testing program, the Yellow Cab Company saw its accident rate reduced to one-half of its former amount! The decrease in accidents obtained during an increase in mileage covered is shown in Fig. 12.

To demonstrate the prognostic value of his test in vocational selection, Snow tested 311 applicants. On the basis of his test results he predicted that 258 of these would be satisfactory, that 34 would be unsatisfactory, and that 19 would not stay long. The validity of his prediction is indicated below.

TABLE 4

Predictive Value of the Snow Drivers' Test

(From Snow)

	SATISFACTORY	UNSATISFACTORY	WILL NOT STAY LONG
Percentage of men who had accidents........	33	64	33
Percentage of men who had more than two...	12	38	0
Average number of accidents per man.......	0.20	1.00	0.16
Percentage of men who quit................	20	19	33

Tests of Motorists. Work on tests for drivers of pleasure vehicles has not advanced so rapidly as have tests for commercial operators. This is natural since in the latter

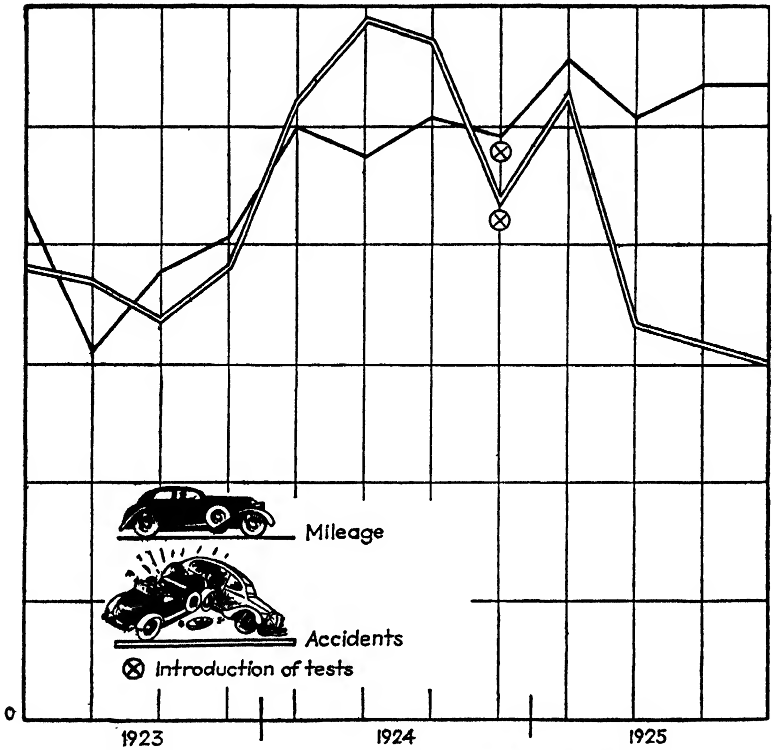


FIG. 12.—The relationship of mileage to accidents before and after introducing psychological tests.

case the work may be supported by companies in hope of reducing their operating costs and accident damage claims. Several important pieces of research have nevertheless been completed.

The work of Moss and Allen on the reaction time of drivers very well illustrates the objective approach applied to actual driving situations. Their apparatus

consisted of two pistols loaded with red paint and attached to the underside of a car. One of the pistols could be discharged at will by the experimenter, the other was set off by a slight pressure against the brake pedal. In either case the red coloring made a mark on the road indicating the exact time at which the discharge occurred. The speed of the car was determined by an accurate chronometric tachometer. Subjects to be tested were told of the nature of the experiment and given an opportunity to familiarize themselves with the machine. They were then told to hold the car at a given speed, whereupon the first pistol was discharged. The subject immediately applied the brake, thus discharging the second pistol. Knowing the speed of the car, it was only necessary to measure the distance between the two marks in order to determine accurately the reaction time in an actual driving situation.

A total of 57 subjects was tested, each subject's reaction time being determined at five different speeds. The average reaction time for all trials was found to be 0.54 second. This would mean that in driving a car at 30 miles per hour the average driver will travel 22 feet between the time when he observes a danger signal and the time when he actually *begins* to apply the brakes. At the high speeds with which cars frequently travel today, this factor can be seen to be of greatest significance.

The following results were obtained in addition to measures of simple reaction time.

1. The relation between reaction time and the variability of the individual. A correlation of plus 0.82 was found between these factors. In other words those with the shorter reaction times also had the most constant

times, whereas the slower drivers were also more erratic.

2. The speed at which the car was traveling did not influence reaction time.

3. Training results in a reduction in reaction time. Thus those subjects with one year of driving experience averaged 0.70 second, while those with four or more years averaged 0.50 second. Ten taxicab drivers whose mileage would equal many years of ordinary driving showed an average reaction time of 0.41 second.

4. Sex, age, and race had no important relationship to reaction time as shown in this study.

The foregoing data have shown that the measurement of reaction time alone does not constitute an adequate basis for selecting good drivers. Studies show that subjects with fast reaction times are actually poorer driving risks than those with average reaction times. This may of course be due to the fact that such drivers are inclined to take chances, but it also indicates that many other important factors may be involved. For instance, the ability to carry out movements involving complicated coordinations may not be found in the same persons who have good reaction times. Recent driving tests devised by deSilva include in addition to some of those tests used by Snow, tests for:

1. Steering
2. Braking
3. Combination braking and steering
4. Speed estimation

Selecting Drivers and Pilots for the Army. So complicated are the factors involved in determining good drivers that military psychologists working on the prob-

lem of selecting the men who are to drive the transport trucks and even the army tanks are inclined to depend for the most part upon the past experience of candidates. There is no doubt that a driver's past record for safety and efficiency offers a good clue to his future performance where such records are available. On the other hand, as we have seen from the work of Snow, it is possible to pick out the accident-prone men on the basis of an adequate psychological testing program. At a time when the efficiency of the mechanized units is so vitally important for military success, it would seem almost self-evident that the installation of psychological testing programs such as those devised by Snow, deSilva, Weiss, and others should be made; and yet a recent review published in the *Psychological Bulletin* shows little evidence of such work to date. Much more effective psychological work has been done in the field of selecting military aviators, possibly because of the greater obviousness of the importance of motor coordinations in the case of flyers. Even here, however, the crude criterion used in the First World War continues all too frequently to operate. This criterion consists in large part in analyzing one's past record, much as in the case of army transport drivers, except that more complete past records are here available.

A pilot's past record is most likely to be summarized under three headings:

1. Graduation from training school
2. Commercial versus private flying experience
3. Accident versus nonaccident proneness.

In the case of both the transport drivers and aviators such criteria are at least better than nothing so far as persons who have had previous experience are concerned. The trouble is, of course, that this method of selection does not lead to the setting up of an adequate program enabling the personnel directors to predict the probable future success of raw recruits. As the military machine expands, the use of these raw recruits will become proportionately greater so that scientific testing methods will have to be inaugurated if the military is to avoid the tragic failure and inefficiency which civilian driving has experienced through its past failure to use scientific methods. Our comments may be summarized by quoting the opinion of Razran and Brown.[1] "It is really difficult to think of another field of such practical importance as that of the selection of aircraft pilots in which so much confusion reigns and in which research has been attempted and interpreted by investigators of such varying background and training." Although the comment of these experts refers directly to the aviation situation, they apparently might be applied with even greater truth to the confusion that reigns in the area of army transport work.

Pseudo-psychology

> There is no art to find the mind's construction in the face.—*Macbeth*, Act I.

The aim of science is to be able to predict and hence to control events in the future. Everyday observation has

[1] RAZRAN and BROWN, "Aviation," *Psychological Bulletin*, Vol. 38, No. 6, p. 326.

exactly the same aim. After we have seen a number of examples of certain things we begin to make generalizations about them. It takes only a few observations to convince the child that all fire is capable of producing painful burns. Scientific generalizations are arrived at in the same way. The chief difference between scientific procedure and common sense lies in the conditions under which observations are made. In science they are made with the aid of exact instruments and the results are carefully tabulated for a large number of cases. Ordinary observations are made in a haphazard manner and unaided memory usually is depended on as a storehouse for them. It is for this reason that generalizations so arrived at are often grossly false. Poor as they are, such efforts are better than none. In many fields of investigation it is not yet possible to do more than make these random guesses.

It should also be remembered that those fields of study that have been able to substitute scientific methods of observation, nevertheless, grew out of nonscientific attempts. Intelligent people no longer believe in astrology, yet we know that the present science of astronomy arose from it. Alchemy constituted the crude beginnings of the science of chemistry. These pseudo-sciences became real sciences when the necessary instruments of precision were developed. In geology many people still rely on primitive ideas. The "water witch" is used to locate the sites for wells and the divining rod for locating minerals—this in spite of the fact that the science of

geology has well-developed methods of doing the same thing through a study of rock formations.

We have more pseudo-psychology today than we have pseudo-physics or chemistry. This is because the science of psychology is younger and hence has not developed the exact techniques needed and so cannot always substitute more correct generalizations for old false notions. Another reason is that psychology deals with ourselves —a topic in which we are highly interested and about which we all have more or less fixed notions and beliefs. Our attitudes, in other words, provide powerful mental sets which make us ready victims of ideas which flatter us or which offer short cuts to self-knowledge. Intense personal interest tends to reduce our criticalness. In times of drought, otherwise rational men follow after rain makers; in affairs of the heart, we fall victim to fortunetellers or write letters to the editors of lovelorn columns of newspapers.

Psychologists have a very excellent reason for concerning themselves with the activities of pseudo-psychologists. Their reason is that these charlatans use the name "psychology" and thus discredit the science. The average person has no way of distinguishing the work of reputable scientists from that of charlatans. Thus during the First World War a group of outstanding psychologists from the American Psychological Association devised the Army Tests of Intelligence. These splendid tests were standardized on thousands of men and immediately showed the possibilities of the use of tests in picking the best men for a given job. The army tests themselves, however, told nothing of a man's special

abilities and so needed to be supplemented by other aptitude tests. These additional tests were necessary before satisfactory work in vocational selection could be done. Reputable psychologists were willing to wait until they could develop such tests before entering actively into the field of industrial psychology. Not so the host of clever hangers-on who saw a quick and easy way to temporary success. The result was that immediately after the war we saw a small army of self-styled "efficiency experts" moving into many industrial plants with the confidence that by applying their untested tests they could revolutionize the plant. Revolutionize it they did in many cases; but without the expected increase in efficiency. The majority of these men were quite untrained in psychology and had little notion of the enormous work and cost involved in constructing accurate tests. Both they and their employers were imbued with the get-rich-quick spirit of past wartimes and felt little inclination to spend time and money on extensive research programs.

Exactly the same encroachment of pseudo-psychology into industry is taking place in connection with American industrial expansion during the Second World War. We already have many instances in which actual physiognomy and other forms of pseudo-psychology have been "sold" to the governing boards of some of our largest war plants. In the confusion of rapid industrial expansion these unscientific systems may be able to maintain themselves for a while. When they are finally discredited, however, the tragedy will be that their failures will not be attributed to pseudo-psychology but

will be chalked up against scientific psychology, and the progress of the latter will thereby be still further hindered. Even today the phrase "efficiency expert," which arose in the First World War, is anathema to most employers, and the opprobrium attached to the worthless tests of these men has tended to be applied to all tests in the field of psychology. The work of the science has been set back 10 years by the quacks who use the name "psychologist." It is small wonder then that the profession is forced to defend itself against this horde of fraudulent promoters.

How can one distinguish between the reputable psychologist and the incompetent? There exists in America an organization made up of the professional psychologists of this country. This organization is called the American Psychological Association. It is patterned closely after the American Medical Association and like the latter has the twofold purpose of maintaining the highest standards for the profession and of promoting the professional welfare of its members. Membership in the association is open only to persons who have a thorough training in psychology and who have demonstrated that they are actively working to promote psychology as a science. There are, of course, many men who are excellent psychologists without being association members, but the fact remains that such membership offers a definite criterion by which any person can be sure that he is dealing with a reputable psychologist.

Physiognomy. Many forms of pseudo-psychology are based upon the idea of a relationship existing between mental and physical traits. One way of arguing is that

of *analogy*. Thus, if a person has a strong jaw, he is thought to have a strong character or to be determined. A broad or high forehead is frequently taken as an indication of broad understanding or high intelligence.

A second type of interpretation is based on supposed *functional relations*. A person who engages a great deal in speculations of a philosophical sort may, to be sure, develop a wrinkled brow. It is clear, however, that this is no justification for assuming that all people who have wrinkled brows are philosophers. To illustrate this point, we might mention that in a recent intelligence test all the Chinese students, owing to a language difficulty, fell below 78. It certainly would not be fair on the basis of this study to conclude that all persons scoring below 78 are Chinese. This type of thinking is nevertheless exactly that outlined by physiognomists. They assume that, because some criminals may have shifty eyes, one can detect criminals by looking for shifty-eyed persons. Naive speculations of this sort are not limited to persons of supposed slight training. Many persons who are assumed to be people of high intelligence and whose opinions bear great weight have been guilty of wild statements along this line.

Thus, in an issue of a Sunday paper, Arthur Brisbane the famous columnist, declared as a positive fact that all great men have blue eyes and long noses. To prove his point, he reproduced the pictures of six great men. Brisbane in the same article said that a strong jaw also goes with a long nose. To illustrate the degree of non-scientific interpretation possible, Brisbane said that while three of the six chins are covered with whiskers,

"You know that there is a powerful jaw back of those whiskers." Just how we know that is not made clear. Brisbane went on to say that, "When the intellect is highly developed the forehead is the dominating part of the face. The jaw is subordinate." Of course, he had just said in the preceding paragraph that great men have powerful jaws. He then stated, "Among brutal men the heavy jaw dominates." Obvious self-contradictions of this type are to be expected in connection with such uncritical expositions.

When men who exert as much influence as did Brisbane show themselves to be so uncritical in fields where scientific knowledge is available, the psychologist is likely to despair of ever disabusing the public of certain of these childish views.

Judgment of Intelligence and Temperament from Physical Traits. Attempts to estimate a person's mentality on the basis of certain physical characteristics are among the oldest "psychological" interests of mankind. What success have such efforts yielded? One can find many self-styled "psychologists" or psychic readers who claim to be able to give you vocational advice as well as to analyze your personality by merely looking at your face or your palm. Intelligent people no longer believe in astrology, palmistry, or phrenology, but all too few realize the dangers involved in trying to judge character or intelligence by similar superficial observation.

Dr. Moss[1] says about judging intelligence from physical traits that, "One can predict as successfully whether a motor is good, bad, or absent by examining the hood

[1] Moss, F. A., *Applications of Psychology*, p. 228.

as he can tell whether the individual is a genius, lunatic, or imbecile by examining his skull." Ample scientific evidence supports such statements. Thus Laird and Remmers had 400 people arrange the photographs of 10 college students in order of their supposed intelligence. When these results were correlated with the actual intelligence of the students as shown by intelligence tests, it was found that the judges would have done quite as well if they had made their selections with their eyes closed. A similar study by Omwake showed a zero correlation between actual intelligence and judgments of intelligence based on handwriting. Even ability to spell showed no significant correlation with intelligence. Pintner in studying the judgment of intelligence from photographs found that the efforts of physicians gave correlations as near to zero as one could expect to get on a pure chance basis. Even psychologists who might be supposed to be able to judge intelligence in this way if anyone could showed the same inability to make correct judgments.

From these and numerous other studies, we are forced to the recognition that one might try to judge intelligence almost as well on the basis of the flip of a coin as upon the basis of these subjective judgments.

Perhaps the question of judging character, temperament, and other personality traits is even more important from a practical viewpoint than the question of intelligence. The honesty of future bank employees, the personality of candidates for positions as salesmen, one's estimation of new acquaintances, these and thousands of other situations arise in daily life. For the most part,

judgments are made upon purely subjective bases, and, what is worse, considerable confidence is placed on the validity of such judgments. Many businessmen feel that a superficial personal interview is all they need to "size up" a man correctly. Yet, in an experiment in which 57 applicants were interviewed by the 12 sales managers of large concerns, it was found that there was almost no agreement as to the best man. One applicant was rated the sixth best by one manager and the fifty-sixth best by another. Yet these men were paid large salaries to "select" more efficient employees. The selection might just as well have been done by drawing lots.

Despite the definitely negative nature of all these studies, there are still plenty of "analysts" who, for a price, will undertake to read character or who will even sell one a system of study through which one will be able to gain this ability. Outstanding among these unscientific students of personality are the physiognomists, those who practice the "art" of judging character from facial features. Among the best known of them is Katherine Blackford whose course on *Reading Character at Sight* in a series of easy lessons is still available in many libraries. A few years ago it was widely advertised and sold in large numbers. Along with an exposition of the traits that are represented by the convex, the concave, and other types of faces, she also advanced her "law of color" in which she characterized the traits of blonds and brunets as follows: "Always and everywhere, the normal blond has positive, dynamic, driving, aggressive, domineering, impatient, active, quick, hopeful, speculative, changeable, and variety-loving characteris-

tics, while the normal brunet has a negative, static, conservative, imitative, submissive, cautious, painstaking, plodding, slow, deliberate, thoughtful specializing characteristics." It would indeed be a most valuable thing if one could tell all these things about a person by simply noting his degree of blondness or brunetness!

In order to check on such high-sounding claims, Paterson and Ludgate conducted an investigation in which 187 blonds and 187 brunets were rated with respect to each of 26 traits by means of a man-to-man rating scale. The results of these ratings by 94 judges are most instructive. If the contentions made are correct, one would, of course, find more of the blonds predominating in the blond characteristics and vice versa. As a matter of fact, as shown by the partial table below, in every trait it was found that the blonds and brunets were almost exactly evenly divided.

TABLE 5

Percentage of Blonds and Brunets Judged to Possess Certain of Blackford's So-called Blond and Brunet Traits

(From Paterson and Ludgate)

	% BLONDS	% BRUNETS
Blond traits:		
Hopeful	85	85
Positive	81	84
Dynamic	63	64
Domineering	36	36
Brunet traits:		
Thoughtful	67	70
Painstaking	56	61
Cautious	54	60
Imitative	39	40

What shall we conclude on the basis of this array of negative data? First it should teach us that intelligence, temperament, honesty, and other traits are not to be

measured in terms of some other variable. If we would know about these things, we must measure them directly. This involves the use of carefully constructed measuring tools. Such instruments can be developed only by careful research carried on by men who understand not only the technique of measuring but the dangers that constantly beset one who works in this field.

Finally, and for most of us this is perhaps the main lesson, we should have learned that there is just about an even chance that we are doing the subject an injustice every time we permit ourselves to make generalizations about the personality traits of our friends or of others. When even psychologists and intelligent school teachers and businessmen who deal constantly with people realize how inaccurate are their subjective judgments, how much more must we distrust our own crude attempts. To make such an attempt or to waste one's money on frauds who claim to be able to do this is a thing that no fair-minded and intelligent person should permit himself to do.

Phrenology. Somewhat cruder than the work of the physiognomists is that of the phrenologists. The notion of phrenology arose from a partial truth discovered by Gall. His discovery was that there is a certain amount of localization of function in the brain. Recent studies have shown quite definitely the limited extent to which such localization exists. Out of this simple misconception grew an attempt to give vocational guidance on the basis of feeling the bumps on the head. It was held that, if the part of the brain having to do with musical ability

were enlarged, it would necessarily push up that part of the skull and cause a small bump. The phrenologist would feel these bumps and then indicate on the basis of them whether the subject should be a musician, bank clerk, or farmer. That such childish notions have not been abandoned in the present day is indicated by the fact that, in certain California cities at least, a company is making large amounts of money through the use of the apparatus called a Psychograph. This is an elaborate-appearing instrument for automatically recording the bumps on the head. These bumps cause writing levers to move and inscribe upon a strip of paper. These wavy lines are then interpreted in terms of an accompanying chart.

This particular instrument has taken many thousands of dollars out of the pockets of visitors to local fairs, motion-picture houses, and other places where it has been exhibited. The money spent on the device is, of course, the least loss. The greatest loss will result in the future years from persons taking these results seriously and thus trying to force themselves into indicated vocations for which they have perhaps no ability whatever.

Judgment of Occupations from Physical Appearance. The great American psychologist, William James, once wrote, "We come by degrees to wear a certain cut of face and figure!" By this he meant that the activities in which we engage in our professional life may cause us to assume characteristic habits of walking, talking, and even of standing. In the same way it is true that, within limitations, some occupations dictate the types of clothing we wear. Such expressions as the "philosophical

slouch," referring to the alleged ambling gait of the philosopher who strolls about the campus engrossed in his thoughts or the pugnacious gait of the boxer acquired as a carry-over from his work in the ring, typify the basis for Professor James's remark. The difficulty with such generalizations is, of course, that, although a philosopher may slouch in his gait, it is also true that he may not, and again true that persons who are in no way philosophically inclined may slouch. It is safe to say that whatever occupational habits we do acquire are not general enough to permit the recognition of occupation from facial expression, posture, or even clothing. Generally it would be impossible to distinguish between a farmer and any other workingman when the two are encountered away from their work.

By way of demonstrating the impossibility of judging occupations from facial types, students were asked to guess the occupations of individuals in each of two groups of six persons. The results of classroom studies of the efforts of 162 students to judge these faces showed that the average student guessed only one right out of each group of six persons.

Probably one of the main reasons for the widespread acceptance of the fallacious notions of physiognomy is the fact that we are all used to looking at cartoons in which the supposed outstanding traits of various occupations are emphasized. One has, therefore, little difficulty in naming the occupations represented by each person in a cartoon. This is because the essence of a cartoon is to exaggerate for purposes of identification and sometimes for purposes of criticism or ridicule. If

the objective is ridicule the feature that is exaggerated is usually some trait that symbolizes a disagreeable aspect of a line of work. Thus, the typical cartoon of a banker presents him to be a sleek, overfed person, whereas that of a professor is likely to be that of a bearded, stooped, nearsighted person. The gangster will usually be shown with traits not likely to be found in the drawing room, although they might be confused with those of a prize fighter. Actually, of course, many gangsters make a point of looking suave and polished.

The upshot of this whole discussion from a psychological standpoint is that, although occupations may leave some imprint, this imprint is likely to be related to a person's activities. Thus the best way to tell which of several men follows a given vocation would be to watch all of them working at it. If an actor, a professor, and a mechanic were all observed while working on a car there is little doubt that the mechanic could be identified. In psychology the observation of behavior under controlled conditions takes the place of snap judgments based on certain supposed cues.

Spiritualism. Spiritualism is an extreme form of pseudo-psychology. Perhaps it could be fairly said that spiritualism is much more than pseudo-psychology in that it deals with many questions that do not particularly interest the psychologist. Spiritualism is not scientific in that it disregards the established techniques for gaining knowledge and depends upon direct revelation of a mystical sort for its information. The psychological drive behind spiritualism is probably that of an escape mechanism in which persons unwilling or afraid

to tackle their psychological problems realistically seek consolation in the belief that the spirits will solve their problems for them. In this sense spiritualism represents not only pseudo-psychology but pseudo-religion; or, as a recent magazine article labels it, the "lunatic fringe in religion." An indication that spiritualism is an escape mechanism is found in the fact that it flourishes during times of economic or political crisis.

Spiritualism is important enough in modern society that scientifically minded people are interested in exposing its predatory activity in milking the public of millions of dollars annually. The *Scientific American Magazine*[1] currently is running a series of articles giving the results of the attempts of sundry psychics to demonstrate spiritualistic or supernatural phenomena. To date the efforts have all been failures and some idea of the confidence of scientists and their conviction that spiritualism is mere quackery may be gained from the fact that the *Scientific American Magazine* working with the Universal Council for Psychic Research has a standing offer of $15,000 to any person who can demonstrate a genuine spiritistic or supernatural demonstration!

SUGGESTED READINGS

BURTT, H. E.: *Employment Psychology*, Chap. 2.
CRAFTS *et al.*: *Recent Experiments in Psychology*, Chaps. 27, 28.
GARRETT, H. E.: *Great Experiments in Psychology*, rev. ed., Chap. 14.
GRAY, J. S.: *Psychology in Use*, Chap. 2.
MOSS, F. A.: *Applications of Psychology*, Chap. 13.
VALENTINE, W. L.: *Experimental Foundations of General Psychology*, rev. ed., Chaps. 1, 2.

[1] *Scientific American Magazine*, 1941.

Chapter 3

FOUNDATIONS OF PSYCHOLOGY

Characteristics of the Scientific Method

THE scientific method is just that—a method. It consists in certain techniques that have been developed for gathering and organizing information leading toward a better solution of our problems. It is customary to divide scientific work into three phases:

1. Observation
2. Generalization
3. Application

The way in which these three processes lead to the solution of human problems, together with a discussion of procedures to be followed and precautions to be noted in each, will constitute the following discussion.

Observation. Man has learned through experience that unaided sensory observation is not always to be relied upon. A scientific experiment is a device for increasing the accuracy of observations. In the first place, the experiment is so arranged that observations under the same circumstances can be repeated either by the same man or by different people. An experiment should, therefore, be repeatable. Because it is not possible for us to observe all aspects of a situation at once, it is necessary to control, if possible, all factors in the experiment. If we can do this and then modify one factor, we can

effectively measure it in terms of its influence on the total situation. An important characteristic of the experiment is the use of measuring instruments. Measuring instruments do not take the place of sense-organ observations, but they do reduce the error of them. Thus a ruler cannot be used to measure, but it can be used to aid the eye in judging distances. In a similar way, telescopes and microscopes extend the range of human observations in the visual field just as stethoscopes and radios extend the range of hearing. All these devices reduce the danger of error in human behavior or extend the range of that observation.

Another characteristic of the scientific experiment which might be mentioned is that *permanent records* are made of the results of the observation. These records are sometimes made directly by the measuring instrument as when we record the heartbeats of a person on the smoked paper of a kymograph. Other instruments, such as delicate clocks, do not actually write the record but they present the record on a dial so that the readings can be recorded in the form of a table. Such permanent records of observations permit us to avoid the dangers of faulty memory. It has been said that Charles Darwin found that he seldom forgot an observation that agreed with his basic theories, but that he frequently forgot observations that tended to go against his theories. Being an honest scientist, he therefore made it an invariable rule to write down immediately every observed instance going against his principles, although he sometimes trusted to memory to retain the observations that favored them.

A last characteristic of the scientific method is that it utilizes *mathematical methods* in the treatment of data observed. Again, this would not be possible had not records of the data been made. We shall see in a moment that an aim of science is to arrive at generalizations. The use of mathematical methods aids in the formulation of generalizations. No science can go very far until it applies statistics to the treatment of its data.

Generalization. The purpose of gathering observations is to permit the making of generalizations. Generalizations are statements of an underlying principle pertaining to the data at hand. When these generalizations have been established only tentatively, they are called "hypotheses." When they have proved to be adequate statements covering greatly increased numbers of observations, they come to be called "scientific laws." Once established, these generalizations are of enormous value in the practical application of scientific knowledge.

Law of Causation. There is one great generalization upon which all science depends. It is called the "law of causation." This law emphasizes the fact that, of all the effects that have been observed among natural phenomena, none has been observed that did not have a preceding or originating cause.

Since we can be assured that every cause has its effect and every effect has a cause, we can go about finding what these cause-effect relations are. Having established them, we shall be in a position to control the world around us through the prediction of effects as soon as we see their causes operating.

Law of Parsimony. A second important hypothesis has to do with the formulation of hypotheses themselves. In the latter part of the Middle Ages, a philosopher known as William of Occam observed that our results will be much more satisfactory if we avoid elaborate and fantastic explanations. This principle was called Occam's razor because, by means of his "razor," he proposed figuratively to cut away all superfluous and unjustifiably elaborate hypotheses. This principle has come to be formulated in the law of parsimony as follows: "Of two otherwise equally satisfactory hypotheses, one should choose the simpler."

The law of parsimony has sometimes been misconstrued through a failure to emphasize the expression "equally satisfactory." The mere fact that an explanation is simple is no guarantee of its validity. In fact some of our widely accepted laws in modern science are quite complex. Such complicated laws are accepted, however, only if there are no simpler explanations available that seem to fit the case.

Application. The results of our observations and generalizations are made practical through applying them toward the prediction and control of events in the future. This is the ultimate goal of science. Despite what we sometimes hear, it is not true that the scientist is an impractical person who is not interested in the results of his observations. Pure science is pure only in the sense that the scientist realizes that he must first arrive at accurate generalizations before he can go on with the practical work. Ultimately, however, scientists, like everyone else, are interested in gaining a greater control

over the forces of nature. They can gain this control if they can learn to predict events in the future.

Thus, if an engineer can predict that a dam is about to break, he can reduce the severity of the catastrophe through warning the people below the dam, or sometimes prevent it entirely by reenforcements. We say then that *the ability to predict carries with it the power to control.* In the field of human sciences, we see the physician controlling disease because he can predict the effect of certain chemicals upon the body and upon the disease germs. We see engineers, because they can predict the strength of steel, building bridges that carry railroad trains safely across canyons. In the same way, the psychologist aims to control certain aspects of human function for the greater benefit of mankind. If he can predict that a given individual will be much more likely to succeed in one type of work than in another, he may save the person much heartbreak and waste of effort. The aim of psychology, as of all the sciences, is the prediction and control of events in nature.

The Scientific Method in Psychology

Method of Introspection. The interest of early psychologists centered around the study of mental processes as such. When it comes to the studying of mental processes, there is only one person who can observe a given set of them. That person is the individual who is experiencing the mental process. In other words, the only way by which a study of mental processes could advance was by having each psychologist try to analyze his own mind. This process is called the "method of introspec-

tion." The method has given us much interesting information of a psychological character, but it is clearly unsuited as a method of attack upon the problems of human abilities and their measurement.

The man who perhaps unconsciously bridged the gap between the old introspective psychology and the newer objective type was a German scientist named Wilhelm Wundt. Although he himself was an introspectionist, he originated the systematic use of psychological instruments. He did this as an aid to introspective study and as a method of gaining certain secondary bits of knowledge. It was left to certain of his students (notably Cattell) to make the objective approach the central interest in psychology. Wundt is known as the founder of modern psychology. It was he who opened the first psychology laboratory at Leipzig University in 1879. From this start, the adapting of laboratory techniques to psychology has advanced until now there is scarcely a university in the land which does not possess these facilities.

We should not leave the topic of introspective psychology without mentioning Titchener. Titchener was one of the early students of Wundt. After completing his years of study with Wundt in Leipzig, he came to this country to establish his own laboratory at Cornell. Throughout a long lifetime of active research, Professor Titchener contributed much to psychology. He also remained a staunch exponent of introspective psychology.

Objective Method. In 1895 Scripture published a psychology textbook called *Thinking, Feeling, Doing.* In the

preface to the first edition we find this statement, "This is the first book on the new, or experimental, psychology written in the English language." The book is devoted almost entirely to a treatment of the various objective (instrumental) methods for observing human action.

By 1910 the movement toward an objective psychology had grown to considerable proportions. In this year Watson began to popularize the idea with his demand for a "behavioristic" psychology. It would be safe to say that by 1920 the great majority of American psychologists were using the objective method almost exclusively. Dashiell has evaluated the progress of psychology toward objectivism as follows: "Objectivism (behaviorism) may fairly be said to have accomplished its mission of restoring the equilibrium of a science of human nature that had gone exclusively mind-gazing with the extreme post-Wundtian introspectionists."[1]

What does "objective" mean as applied to psychology? It means that the psychologist is concerned with observing the actions of animals or human beings instead of observing himself and his own mental processes. These observers make use of instruments of precision wherever possible. Students become acquainted with many instruments for observing and recording behavior during an introductory course.

Fields of Psychology

We have seen that psychology interests itself in the activities of living organisms. This definition outlines a field so broad that it must be subdivided for effective

[1] DASHIELL J. F., *Fundamentals of General Psychology*, p. vii.

work. It will be desirable for us to acquaint ourselves with the main subdivisions of the field of psychology.

General psychology deals with the normal human adult. This is the broadest field both as to its importance and as to the amount of work done. This is appropriate since general psychology naturally includes the majority of human beings. A great deal of experimental work has been carried out using normal human adults as subjects. As a matter of fact, one of the biggest problems of psychologists is to get human subjects who can be used for experimental purposes. Since most experimental psychologists nowadays are also teachers of psychology, it has happened that they have used their students for the most part as subjects in their experiments. Likewise the majority of beginning psychology students are sophomores in college. All this has led some facetious person to remark that general psychology is really the psychology of the college sophomore. At any rate, general psychology constitutes our central interest and many of the other fields of psychology are interesting to us in part because of the information they can bring to this field.

Animal psychology or comparative psychology is a study of lower animals. Workers in this field enjoy an advantage in that the psychological processes in animals are usually simpler than they are in humans and in that animals can be controlled in ways which are often not possible with humans. For these reasons, animals, especially white rats, cats, dogs, and monkeys, have been very widely used as subjects for psychological experiments.

Child psychology is a most important field. By studying the development of children, we can trace the beginnings of many psychological processes which we might never understand if we saw them only as a finished product in the adult. Child psychology is important also because it helps us to answer questions as to the best methods of child training, how to overcome childish fears, and how to discover special abilities or defects in children so that they may be taken into consideration in planning the child's future.

Abnormal psychology studies those extreme deviations from normal behavior which are variously classified under the headings of insanities, neuroses, and other nervous problems. Abnormal psychology has been called the microscope of normal psychology because here we see many marginal forms of normal human behavior exaggerated to the point where they can be studied more accurately than they could be otherwise. Abnormal psychology, then, helps us to understand normal psychology and also, of course, throws light upon the ways in which we can be of service to those unfortunate people who are victims of psychological abnormalities.

Social psychology deals with the behavior of humans in groups. The central problem is to trace the process by which the untrained individual becomes a personality through learning the correct responses to social stimuli. Social psychology occupies an area midway between that of psychology and sociology.

Applied psychology may be thought of as the field concerned specifically with the application of the knowledge obtained in any of the preceding fields to

specific problems relating to human welfare. Actually applied psychology is made up of a number of specific technological fields such as educational, clinical, and industrial psychology. Under industrial psychology we find such problems as advertising, time-and-motion studies, personnel work, and salesmanship.

Psychology Studies Adjustment Processes

The processes by which one living being adjusts to others may be reduced to two. An organism can react positively or negatively to its environment. Positive response is characterized by action designed to bring the object closer to the stimulating body and to continue relationships between the two. Negative response is characterized by a moving away from the stimulating body and a tendency to discontinue contact with it. The importance of these basic processes can best be shown by a study of simple forms of life.

The Amoeba. The biologist Jennings has shown that even single-celled forms of life such as the amoeba react positively or negatively to their environment. The positive type of reaction may even assume the form of pursuit movements as when an amoeba was observed pursuing and capturing a euglena.

The Paramecium is another single-celled form of life which illustrates our point. By means of cilia the paramecium is able to propel its cigar-shaped body forward or backward. Upon encountering unfavorable environmental conditions such as a mild acid in the water, the paramecium will reverse its movements, back away, and then start forward again in a slightly different direction,

repeating the process if it again encounters the injurious substance. This picture of the paramecium's mode of attack upon a new element in its environment is closely analogous to the situation at higher and even human levels.

Problem of Native Action Patterns

The conventional classification of unlearned responses in the order of their complexity is tropism, reflex, and instinct. In the view of a few psychologists, all these responses are held to be learned, some of them, to be sure, having been learned prenatally. A more common view among psychologists today, however, is that the tropisms and reflexes are probably unlearned responses, but, rather definitely, that instincts are not. Confusion over this matter has constituted such a serious handicap to certain phases of psychological development that the question of instincts deserves some study.

The early part of the twentieth century was marked in psychology by a strong controversy as to the nature of these instincts. Various psychologists drew up long lists of supposed instinctive acts. McDougall gained worldwide fame through his book *Social Psychology*, in which he explained the origin of the social life in terms of instinct. His definition of instinct will give a notion of what these men had in mind when they used the term. McDougall said an instinct may be defined as an inherited tendency "to perceive, and to pay attention to, objects of a certain class, to experience an emotional excitement of a particular quality upon perceiving such an object, and to act in regard to it in a particular

manner." An important part of McDougall's definition, it will be seen, is his tying up of emotions with instincts. The emotions may be said to be a part of the total instinctive patterns, according to him.

The first attack upon this older view of instincts took the form of a critical study of animals to determine whether or not their behavior really was unlearned. Such study soon showed that many so-called instincts were not unlearned at all but were acquired through early associations and experience. Watson and others studied both animal and human young and came to the conclusion that there were perhaps no instincts at all unless one considered basic emotional or reflexive responses to be such.

Noninheritance of Acquired Traits. Many widely accepted fallacious beliefs of a psychological nature may be traced to notions related to the problem of instincts. Probably the most flagrant of these is the idea that we inherit social concepts such as right and wrong, a knowledge of how to behave in social situations, and the like. One can scarcely read a story without coming upon the statement that so and so instinctively moved out of danger, felt an instinctive urge to help someone else, or felt his conscience hurt him. The point we wish to develop in this connection is that we do not inherit *ideas* of any kind. The only thing that is inherited is the physical structure of the nervous system and other parts of the body.

It used to be thought that changes taking place in the mind or body of a person might be handed down, to some extent, to the offspring. Thus it was argued

that the children of blacksmiths would in general be stronger than other children because their fathers had developed so much strength in their work. A more vicious interpretation based on the same idea was that if a man became a criminal his acquired criminal mind would be passed on to his children. Certain misguided persons have even gone so far as to suggest the sterilization of habitual criminals so that the "taint" of criminalism might not be passed on. Examples of this kind illustrate a very common form of fallacious reasoning. In the case of the blacksmith, for instance, it may very well be true that the children of blacksmiths will be above average in strength. The actual sequence of events, of course, is that the father became a blacksmith in part because he was born strong and that, since he was born strong, he tends to pass on to his children the same traits that he himself has. The children would have been just as much above average in strength regardless of the occupation pursued by their father. In the case of the criminal the explanation is somewhat different and probably more obvious. It may very well be true that the children of criminals have a slightly greater tendency to become criminals than do other children. We readily see, however, that the cause of criminalism is the undesirable early environment of the child and not any hereditary tendency toward criminalism. Similarly, since an unduly large proportion of prostitutes are feebleminded, it might be argued that feeblemindedness carries with it a tendency toward prostitution. Applying our law of parsimony it would seem more reasonable to explain the relationship by the fact that

feebleminded women are unable to compete successfully in the struggle for existence with persons of normal ability. They are therefore driven by sheer economic necessity into antisocial forms of conduct. This is especially true since their feeblemindedness renders them incapable of making fine judgments as to the distinction between socially acceptable and socially nonacceptable lines of behavior. This latter explanation is, of course, quite different from the old one that implies that some of us are "just naturally born bad."

An even more naive line of thinking is that of a belief in *prenatal influence*. Probably most people have outgrown this idea. In some cases today, however, we still find mothers who believe that by attending musical concerts or practicing assiduously at the piano they can improve the chances of their unborn child's being born with musical talent. Birthmarks are often explained by a similar application of the idea of prenatal influence. In all these cases the same principle applies. If the trait in question is one that may be inherited, it will be passed on to the offspring according to Mendelian law. If it is not, no amount of environmental influence will cause it to appear in the children.

Logic of Structure

The most accepted present-day view as to the origins of behavior finds its explanation in what may be called "the logic of structure." It has become increasingly apparent that many types of supposedly unlearned acts are not unlearned at all but have resulted from the fact that the bodily structures concerned are so highly spe-

cialized that they cannot act easily in more than one way.

A comparative study of animals' structures shows that those animals possessing the least highly specialized structures are the animals most characterized by an apparent lack of instincts. Within the cat family, we may find two animals which illustrate this point. Thus, the saber-toothed tiger was very highly specialized as to structure. Because of this specialization, its conduct was narrowly restricted. Indeed, when the environmental situations favorable to its necessary behavior changed, the animal was unable to modify its conduct and so was doomed to extinction. The familiar house cat, on the other hand, is relatively nonspecialized. Accordingly, we find this animal adapting itself to a wide variety of conduct ranging from the untrained career of the alley cat to the domestic life of a pampered Angora.

Another of the ways in which structure determines behavior that might at first glance be thought to be instinctive is to be found in the buffalo. This animal always faces into a storm, whether standing or lying down. Other game animals, such as deer and elk, and domestic animals, such as horses and cows, invariably turn tail to the storm. The explanation of this reversal of behavior lies in the fact that the buffalo is provided by hereditary structure with an extremely heavy coat of matted hair on the head and shoulders, whereas the rest of its body is less heavily covered. It is undoubtedly this structural difference and not an instinct that determines its unique behavior.

Naturalists have long observed that nature seems to have taken two distinct paths in developing adaptive mechanisms in animals. One path is that of *specialization* of structure, carrying with it the necessary restrictions

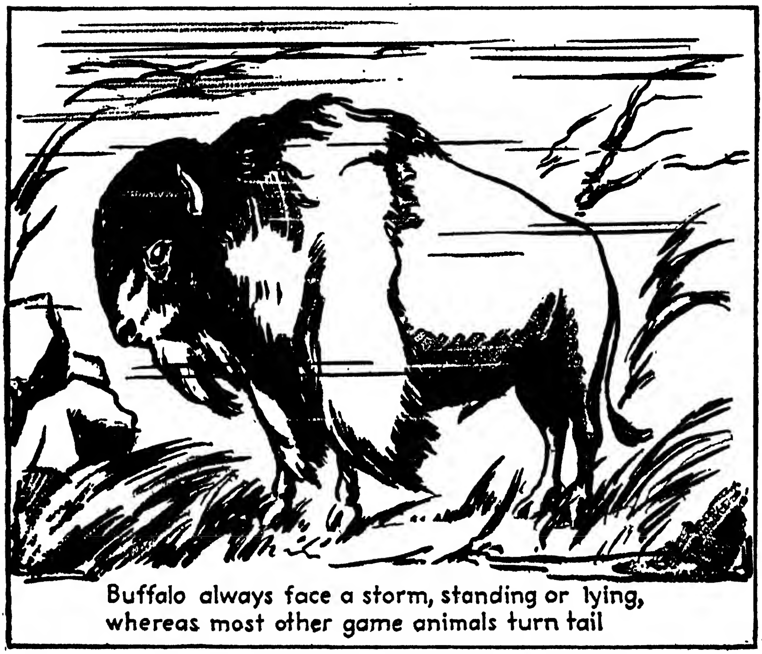


FIG. 13.—An illustration of the "logic of structure."

in the types of conduct possible. The other is the path of *nonspecialization*, carrying with it a wider range of adaptability to new situations. Man probably represents the most extreme and the most successful example of adjustment through nonspecialization.

If the logic of structure explanation of supposed instincts be accepted, we should note that such conduct is not unlearned; but rather that the uniformities

resulted because the trial-and-error learning activities of specialized animals inevitably settled into patterns which their structures made easiest and most effective.

Not all differentiating structures are ready for operation at birth. Certain structures mature at various stages in the development of the animal. As this occurs we may expect to find the animal experimenting with and settling upon new lines of conduct. This fact has been expressed by the statement that observed uniformities in the behavior of animals are the result of *maturation plus experience.*

The baby kangaroo is born while still relatively undeveloped. For that reason, it is necessary for the mother to place the baby in her pouch where it is literally force-fed by glands there. Later, as its muscles develop, it is able to move about independently, will crawl to the ground, and will there experiment with walking activities. Given the structure of legs and tail, as found in the kangaroo, it is clear that these early efforts of the baby kangaroo will inevitably settle into the hopping movement familiar to all who have seen these animals.

The human baby is born in a more highly developed stage than is the kangaroo baby. It may be that sucking movements are present in the baby as inborn reflexes, but as the baby matures and teeth appear, it experiments with new ways of acquiring food. Now, the child is not highly specialized with regard to his food-consuming equipment; therefore, unless carefully trained, he may stumble upon a wide variety of methods of taking food. Almost any of these random methods may be quite effective as far as getting the food is concerned,

although many of them may not be particularly acceptable according to our present social standards.

Studies of Supposed Instincts

The idea that behavior appears as a necessary outgrowth of specialized structure is nicely shown by certain studies on embryonic animals. Coghill has studied the beginnings of swimming movements in the salamander. He finds that the first movement consists in a bending of the body to the left, a flexion which moves progressively along the body to be followed by a bending of the head end to the right. These two simple reflexes result in the animal's taking an s-shaped form which actually constitutes the swimming movements of the salamander. Closely related to this study is that of Carmichael who divided a batch of frog embryos into two groups. One group was allowed to develop normally while the other was placed in a solution which temporarily paralyzed them but did not interfere with their growth. When the two groups of tadpoles had reached a given development, one group was swimming freely and the other was lying motionless in the water. At this point the drugged water was replaced with fresh water with the result that in a very few minutes the drugged tadpoles which had no practice in swimming were swimming as efficiently as the other group. Here, as in the case of the salamander, the structure of the animals is so simple that the only possible muscular contractions are those which result in swimming movements.

Studies of the embryonic chick show definitely the origin of the pecking reflex in this animal. Before the

chick is hatched movements of its head have been observed which correspond to the later movements in pecking. Indeed, it is this forward thrusting of the head which results in the chick breaking and escaping from its own shell. Studies of the later development of the pecking instinct in chicks show that the movement itself is determined to the point that very little practice is necessary to perfect it, provided the physical structures are mature.

When we turn to the consideration of more complicated forms of behavior, we find that the apparent precision of so-called "inherited behavior" disappears. One of the favorite stories of early naturalists is the one related to the behavior of the Ammophila wasp. This insect provides for its young by first digging a hole in the mud, depositing its eggs therein, and then seeking a caterpillar which she paralyzes by stinging it in its principal nerve ganglia. Thus paralyzed, the caterpillar will remain alive and so not decay until such time as the wasps can hatch and feed upon it. It used to be supposed that each of these movements was exact and unlearned, that the wasp would use only a certain species of caterpillar, and that it always stung the caterpillar in exactly the right place on its first trial. Later more careful studies proved that the wasp would select any of a number of caterpillars and that it frequently had to sting the caterpillar several times before striking the ganglion nerve. As a matter of fact it sometimes stings the caterpillar so many times as to kill it with the result that the caterpillar decays before the eggs are hatched. Other times its stinging efforts are so unsuc-

cessful that the caterpillar has been known to revive before the eggs hatch and thus reverse the feeding program intended by the mother. The point involved in all this is that the unlearned behavior will be no more specific than the physical structure of the animal dic-

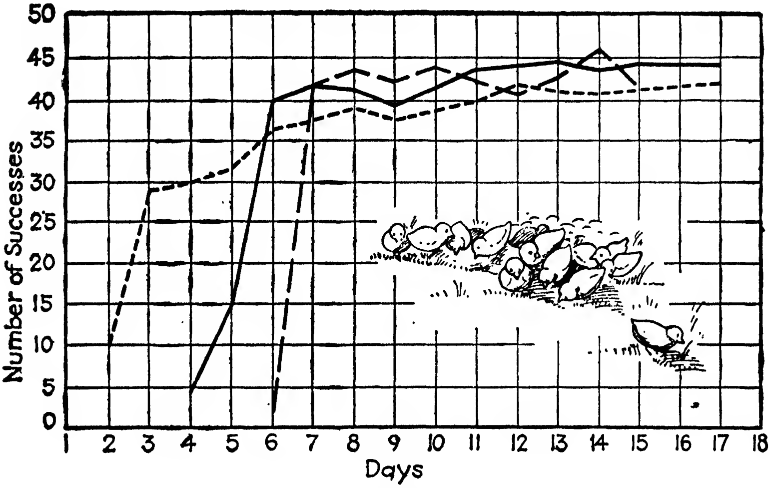


FIG. 14.—The development of pecking ability in baby chicks. (*From Breed and Shepard.*)

tates and that beyond this point the behavior will be the result of a trial-and-error learning process.

Studies on Pecking in Chicks. The relation of trial-and-error learning and maturation to the development of so-called "instincts" has been nicely shown in the studies of the pecking instinct in baby chicks. In these experiments it was learned that baby chicks do not show anything approaching perfection in pecking at birth. Some of the newly hatched chicks missed as much as 50 per cent of their trials. An experiment

performed by Breed and Shepard consisted in allowing one group of chicks to peck at will from the time of hatching. Chicks in a second group were kept in the dark and fed artificially for 4 days before being allowed to peck. A third group was held in a similar way for 6 days. The development of skill in pecking by the three groups of chicks is shown in Fig. 14. This chart shows that the second and third groups of chicks improved much more rapidly than did the first group. Thus by the end of the first day of practice the chicks in the third group had surpassed the first group which had been practicing for 5 days. We can conclude from this experiment that the pecking instinct does not provide a pattern of action but rather a tendency to act which must be perfected by practice, the rate of improvement of which will be dependent upon the maturation of the muscles and bones of the chicks. During the 5 days in which the chicks in group three were kept in the dark and artificially fed they had been growing rapidly. Their muscles were by then quite strong. The chicks in group one were, of course, also maturing during the same interval. The difference is that the early habits of the chicks in group one were established when their muscles were undeveloped so that proper coordination was hindered. One might say that the chicks in group one were handicapped by having formed bad habits in the first part of their training period.

The early work of Breed and Shepard reported above has been elaborated and, in some respects, modified by later workers. For instance, Padilla showed that if the opportunity to practice pecking was delayed

beyond 14 days, the chicks lost any tendency whatever to peck and would actually starve to death in the presence of food. In this instance we see that the maturation or growth of structure is certainly not accompanied by any maturation or growth of a possible instinct. In another study Cruze obtained results which corresponded quite closely with the original results of Breed and Shepard with the addition that his final conclusions were that maturation of physical structure is very important in relation to reducing the number of errors during the first 5 days. This means that the very young chicks made errors (missed the grains pecked at) chiefly because their muscles and bony structures were not sufficiently developed to permit smooth functioning. Later total response activity, especially the act of swallowing the grains, he concluded, was almost entirely the result of practice. These conclusions indicate quite definitely that the two factors of maturation and practice are the important things in determining the development of pecking capacity in chicks rather than any inborn functional ability such as had previously gone by the name of instinct.

Studies of the Mice-killing Instinct in Kittens. To test the question of the alleged instinctive tendency of cats to kill mice, Kuo raised groups of about twenty kittens under each of three conditions: (1) the kittens lived alone and were kept from any possible contact with mice or rats; (2) kittens were raised in a cage with their mother and every fourth day observed their mother kill a rat or mouse outside the cage; (3) kittens were raised in a cage with one rodent and saw no other cats except

the mother, who was brought into the kitten's cage at night, until they were weaned. The mouse was, of course, removed from the cage during the time the mother cat occupied it. The test of the instinct consisted in presenting each of these groups of kittens with opportunities to kill mice after they had been conditioned in the above manner. Table 6 below summarizes the results of the experiment. It will be noted that kittens raised under condition 3, which involved constant contact with mice, were the very ones who showed almost no tendency to kill them, whereas group 2, which had seen rats killed, became relatively efficient killers themselves. The first group killed about half as many mice as the group that we might call "trained" killers.

TABLE 6

Showing for Each Condition, the Number of Kittens That Killed Any Rodent

CONDITION	NUMBER OF KITTENS IN THE GROUP	NUMBER OF KITTENS KILLING ANY RODENT
1	20	9
2	21	18
3	18	3

The experiment would seem to show that kittens raised in intimate contact with mice from their early age form habits that have nothing to do with mice-killing. Kittens that have never seen mice in all probability come in some instances to kill them as accidental results of random play activities. Kuo concludes that kittens have no hereditary tendency whatsoever to kill mice, but that because of their size and body structure they may rather easily learn to do so. In other words, kittens may learn mice-killing habits, whereas other animals such as horses or even dogs normally would not, because

it would be extremely difficult for them to form such habits.

Other Studies of Instincts. It would be incorrect to say that psychologists have explained all so-called "instincts." They have, however, investigated many of them, and in each instance the answer to the question is about that found in the case of the chicks and the kittens. The question of migration in birds has been studied by Rowan, and that of fishes by Roule, Greene, Ward, and others.[1]

Studies of Infant Behavior

So far as the studies upon human young are concerned, the evidence is even more complete that humans probably have no native patterns of action at all. Recent studies by Shirley, Gesell, Thompson, and others suggest that even such fundamental responses as Watson's emotional responses to fear or anger stimuli are actually not innate but are acquired as a result of experience. In the human more than in lower animals, the situation seems to be that the baby gradually develops a tremendous potentiality for action. The great flexibility of his physical body makes possible, as it develops, the performance of an almost unlimited number of activities. The energy that is latent in the system is released by the stimuli that come to it and finds expression through the various motor channels. It is for these reasons that the early conditioning or training of children is of such tremendous importance.

[1] Students are referred to the excellent discussion of experimental studies on instincts included in Crafts *et al.*, *Recent Experiments in Psychology*, Chaps. I and II.

The steps in the development of basic movements have been carefully traced in the human body. Beginning with the embryonic child, Coghill and others have observed the origins of manipulative activities. Movements of the head, arms, and legs occur as early as the third month, whereas the glands of the stomach are operative by the fifth month.

The newborn babe exhibits behavior that consists almost entirely of the simple reflexive types of action, such as sneezing and crying. Random movements of the head, arms, and legs also appear within a few minutes after birth. The Babinski reflex and the grasping reflex are interesting examples of behavior present at birth. If the sole of the baby's foot be gently stroked, it will be found that the big toe will flex itself upward while the other toes curl down. This movement constitutes the Babinski reflex. Its disappearance after about the sixth month is commonly used as one of the indications of normal maturation on the part of the child. In the grasping reflex the child will be found to close his fingers firmly over any small rod which may be pressed against the palms of his hands. Once grasped in this way the child will cling with such tenacity that he may be lifted clear of the bed and will support himself for as long as 60 seconds. Sucking movements, though not perfect at birth, become coordinated very rapidly, usually within the first hour. On the other hand, the movements of the head so as to take the nipple are not so well developed and require a longer training period.

The relation of maturation to the appearance of new forms of behavior in the child is nicely shown in the

development of walking and talking. These activities are not inborn but develop on the basis of trial-and-error activity as soon as the necessary physical structures are sufficiently mature. Where intelligence matures with unusual rapidity the functions of walking and talking mature earlier also. Thus gifted children learn to walk at an average age of 13 months. They begin to talk at an average age of 11 months. Feebleminded children, on the average, begin walking at the age of 25 months and do not begin to talk till the age of 35 months. It should also be noted here that the feebleminded child walks before talking, whereas the gifted child talks before it walks. The reader is cautioned against making judgments as to the intelligence of normal children on the basis of whether walking or talking appears first.

Handedness. One of the most interesting questions relating to the biological basis of action is that of right- and left-handedness. Even today there is no absolute proof that handedness is either learned or unlearned. About 90 per cent of the adult population are right-handed, 5 per cent are left-handed, and 5 per cent are ambidexterous or able to use both hands. Despite this prevalence of right-handedness, it has been impossible to prove any physical differences of the hands or arms or of the brain which might account for this. In addition, the studies of early infant behavior by Watson and others show that the young baby is quite universally ambidexterous. The fact that young babies are ambidexterous does not, of course, prove that later maturation might not bring about changes favoring right-handedness. Although the problem is still not definitely de-

cided, the majority of psychologists tend to feel that handedness is largely a result of social training.

In this connection we have a suggested answer to the question of whether or not a child should be forced to change from left-handedness to right-handedness. If handedness were inborn, it would seem undesirable to attempt this. If it is socially acquired, the desirability of changing over will depend upon how firmly the habit is established and upon the health of the child. If the child is already nervously inclined, the upset of this habit, if it has become deep set, may lead to nervous difficulties sometimes as severe as stuttering and stammering. The best that one can say is that it is much more convenient to be right-handed than left-handed. If the change-over can be made without apparent strain to the child's nervous system, it should be done. If the child reacts negatively by increased nervousness or others signs, it would seem best in most cases to abandon the attempt.

Early Adjustment Patterns

Among the generalized patterns of behavior that develop very early in the child are those relating to the fundamental biological and earliest social activities. These activities may be classified for ease in studying. A partial list of such activities follows:

1. Adjustment of the Sense Organs. The ability to focus the eyes upon a stationary or moving object should have been developed by the third month. Typical responses to sound can be observed in children. Loud noises cause a general tensing of the muscles together

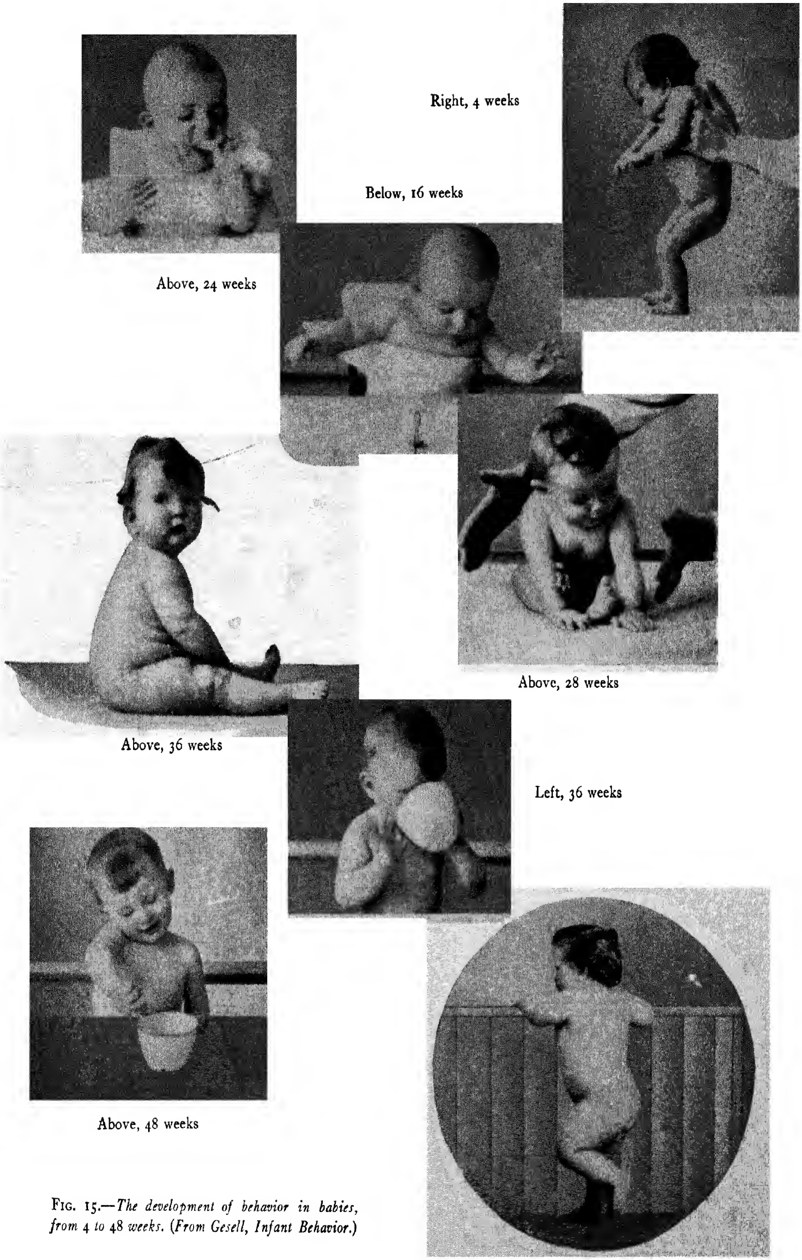
with crying and a general withdrawing behavior. Each of these adjustment activities should be thought of as a pattern of movement developed by the child in the earliest days of his life. Reactions to smell and taste develop more slowly than do visual and auditory responses.

2. Seeking and Accepting Reactions. Very early the child learns to reach out his hands for the bottle or later for any bright-colored object.

3. Protective Reactions. When the child experiences a sudden loss of support, he will exhibit a more or less definite pattern of movement. These involve a gasping of the breath, a tensing and drawing in of the arms, followed by generalized escape efforts.

4. Locomotion. It has been well established that walking is not an instinctive ability on the part of the child. Rather he engages in a wide variety of random movement of his arms and legs. These are gradually organized through experience, first into crawling activities and later, as the muscle and bones of the legs develop, into actual walking. It may be noticed here as an example of the logic of structure how the type of locomotion fits the logic of the stage of development of physical structure. Thus when the legs are weak, the child progresses on all fours, but, as maturation continues, he experiments with improved methods of locomotion.

5. Vocalization. Sneezing has been established as the first sound produced by the infant. Rapidly following this occasional first sound is the more usual birth cry. The birth cry should perhaps be classified as an un-



Right, 4 weeks

Below, 16 weeks

Above, 24 weeks

Above, 28 weeks

Above, 36 weeks

Left, 36 weeks

Above, 48 weeks

Above, 44 weeks

FIG. 15.—*The development of behavior in babies, from 4 to 48 weeks.* (*From Gesell, Infant Behavior.*)

(*Facing page* 86)

learned response, although in terms of our discussion it is more logically viewed as an automatic result of expulsion of air from the lungs. Birth cries and, indeed, practically all the early vocalization consist in tonal elements. We shall see shortly that tonal elements are simple forms of sound resulting from the driving of breath past the vocal cords. As such they require no training at all and only slight experimentation in the form of accidental changes in the tension of the vocal cords to produce differences of tone. From these earliest stages, vocalization proceeds through trial-and-error practice until we find the actual development of speech.

6. Manipulation. The ability to handle objects in the environment is certainly not to be thought of as innate since the objects in the environment of each child differ, not to mention the fact of differences between the environments of a modern child and those of a child of neolithic times. Nevertheless energy does express itself through activities of the hands, and, since the hands are so built as to grasp objects, we observe manipulation as among the earliest patterns of behavior.

7. Emotional Responses. One of the early studies in child psychology was that carried on by Watson on the appearance of emotions in infants. As the result of his experimental observations, Watson concluded that the inborn emotional behavior of the baby is very simple. In fact, he recognized but three types of unlearned emotional responses, *viz.*, *fear*, *love*, and *rage*. He concluded that fear can be brought about by only two natural stimuli: a loud noise and the loss of support, as when a baby is suspended over a crib and allowed to

drop for a few inches. Later studies suggest that even these simple responses may be learned. Many psychologists now think that any fairly intense stimulus will bring out a set of convulsive muscular actions, which have been classified by some psychologists as the "startle" pattern. Watson believes that the love response, which in the child is very generalized, is elicited by stroking the skin or any other gentle rhythmic form of stimulation. The response of rage seemed to be aroused at the outset by anything that restricts the baby's movements, as when he becomes tangled in his bed clothing or when his arms and feet are held down so he cannot move them. Responses resembling what we later call the emotions of fear, love, and rage do appear rather early in infancy, but many modern psychologists would go even further than did Watson and find that all truly patterned emotional responses are learned.

Adolescent Adjustment Problems

The period of readjustment during the teen years offers an illustration of the way in which even minute changes in structure may affect action patterns. The changes during puberty also show that glandular changes should be included in the general concept of "logic of structure." Early psychologists, led chiefly by G. Stanley Hall, were much impressed by the fact that the adolescent has to pass through a period of "Sturm und Drang." Emphasis upon adolescence as a period of storm and strife has not been continued by later psychologists, and yet we are now able to see the

basis of the maladjustments that occur during puberty. The physical changes during puberty are closely related to changes in the endocrine functions of the sex glands. These secretions not only bring about changes in gross physical structure but also regulate the appearance of the secondary sex characteristics. Puberty also marks the definite appearance of the secretions of the primary sex or duct glands.

The physical changes brought on by the endocrine sex glands include such things as changes in the relative size of various parts of the body, modifications in the musculature of the body including changes in the muscular functions of the vocal chords to produce the change of voice, and the appearance of pubic and other hair growths. All these physical changes mean that muscular coordinations that previously resulted in balanced bodily activity now produce movements that are decidedly clumsy and inefficient. During the period in which the youth is retraining his muscles he is likely to be accused of being all thumbs and of being a "stumble heels." The fact that he is unable to control his vocal apparatus is also a source of ridicule. These conditions might not have disturbed the adolescent unduly at a later date, but now they are accompanied by the appearance of the sex activity, which causes the young person for the first time to become acutely aware of his social environment. For the first time perhaps, the youth really wants to fit into society. Because he cannot, he frequently sets upon various substitute adjustments such as extreme seclusiveness, pretended toughness, or the finding of refuge in gangs made up of other fellows.

This period of adolescence, then, is a period of readjustment, the severity of which may be greatly reduced by encouraging him to form new muscular habits through social dancing, games, and parties in which care is taken that his awkwardness is not made a subject of comment. The psychological problem is solved when successful new habits of action are established to meet the basic muscular and glandular changes. We have here, as we had in the case of learning to walk, an excellent illustration of the operation of the twin concepts of logic of structure and of maturation.

Individual Differences

All animals, whether they be humans or lower animals, show individual differences in physical appearance and in capacity for response. Everyone knows, of course, that no two people have the same fingerprint. It is not so well known that in a similar way no two people have exactly the same kind and degree of social or abstract intelligence or of physical strength or quickness. The study of individual differences constitutes a fundamental part of modern psychology. This study leads immediately to a consideration of the relative influences of heredity and environment.

Heredity as a Limit-setting Factor

Hereditary differences in structure may determine the actual kinds of behavior on the part of lower animals. In the case of humans this probably does not occur. Hereditary limitations upon the human operate instead to limit the extent of one's behavior but not the particu-

lar form it shall take. Thus a feebleminded child may not be able to do difficult theoretical work, but, within the limit of his ability, he may be able to master a considerable variety of things.

Sir Francis Galton was the founder of systematic studies on individual differences. His recognition of the importance of hereditary factors grew out of his studies of the family lineage of great men. Galton showed that great men tend to be born into families in which great men have preceded them. It is quite true that a great many may appear from humble origins, but the mathematical probabilities are far greater that they will appear from families of superior stock. A great number of studies in connection with development of intelligence testing have contributed to this. Terman, for instance, found that among the parents of 644 gifted children, there were 73 families contributing 2 gifted children per family. This is 1,200 times as great a percentage as would be allowed by chance alone.

The importance of heredity in determining basic abilities has been amply demonstrated in the field of lower animals. Going beyond the facts of breeding known to every livestock fancier, we may refer to such studies as that of Tryon on the inheritance of maze-learning ability in rats. Tryon started with two groups of rats, one of which was extremely bright and the other very dull. Selective breeding based on maze-learning ability was then carried out for several generations. The results proved that differences in ability to learn to run a maze are definitely inherited. Thus in the fourth generation of rats, the group of 48 bright rats averaged 933

seconds to complete a maze, whereas 49 dull rats averaged 1,458 seconds to complete the same maze. In terms of errors in connection with maze learning, the differences between the two groups for successive generations are shown in the following table.

TABLE 7
Errors in Maze Learning
(From Tryon)

NUMBER OF GENERATION	BRIGHT RATS	DULL RATS
1st	56.26	62.97
2d	66.36	77.16
3d	43.12	62.73
4th	39.27	86.97

Environment as a Directive Agent

Environment determines the specific kinds of behavior which the individual shall develop. This is particularly true of humans in that the inherited structures are so nonspecialized that they may be used equally well for a large variety of activities. It has been pointedly observed that by the time we are born it is too late to do anything about our heredity. The job of the psychologist becomes then one of using the hereditary equipment to the best possible advantage. Methods of education and other forms of social conditioning become then a primary concern of our science.

That environment can operate only within strictly limited areas as determined by heredity has been clearly shown by a number of studies using the twin control method. In general this consists in seeking an instance where twins, or in some cases brothers and sisters, have been separated at early ages or placed in homes constituting strikingly different environments. In such cases

it is possible to determine whether or not the difference between the twins or the siblings is greater than that to be expected for children of the same degree of relationship raised in similar environments. Using the co-twin control method, Burke's conclusions are that 80 per cent of individual differences are determined by hereditary factors with only 20 per cent accountable by environment. Leahy as a result of his study made the much more drastic claim that only 4 per cent of individual differences are properly attributed to environmental factors. As a result of an analysis of 10 pairs of identical twins who were reared apart, Schwesinger concluded that the differences in their environments resulted in an average difference in intelligence of about 7.7 points of I.Q. Good I.Q. tests show a permissible variation of five points of I.Q. on retesting. Hence it will be seen that the difference between the children as a result of their different training was actually little greater than that which might be expected to show on the retesting of children raised in the same environments.

Despite the fact that most studies show but a limited effect of environmental changes so far as basic capacities are concerned, we must not forget that environment will determine almost exclusively whether or not whatever capacities are available shall be used. Also we should remember that, once the individual is born, environment remains the only factor with which we can work in improving the person's lot. A wag has said that the most important choice one has to make is the choice of one's parents. Since this, of course, is no choice at all, our next and, as a matter of fact, only choice is that of using our

environment to get the best results possible from whatever heredity has given us. It should be noted that this manner of speaking refers only to the individual as such. When one views the problem from a sociological angle, the situation is entirely different. Here it becomes the central problem of society to see to it that children are supplied with superior parents.

Types of Graphic Portrayal

The study of individual differences has brought us certain basic facts as to the nature and distribution of

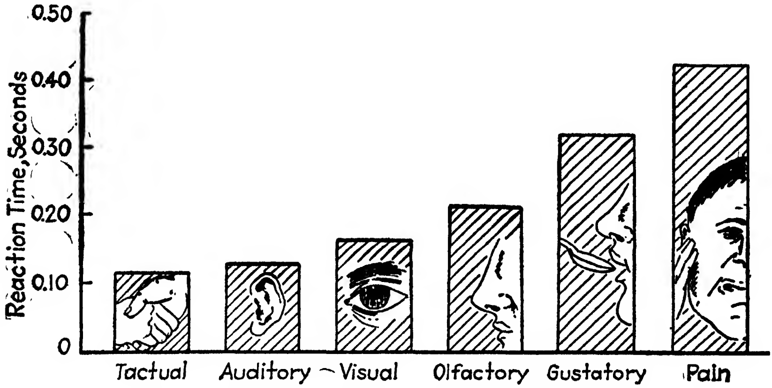


FIG. 16.—Reaction times to various types of stimuli.

physical traits. These facts result only from accumulation of enormous numbers of measures covering all phases of physical structures and of psychological functioning.

The result of such studies must be given statistical treatment, and they are commonly portrayed by means of graphic devices. A graph is literally the picture of the result obtained from a series of measurements.

There are two common varieties of graphs. The first is the bar graph, in which a column is elevated on a base line to a height corresponding to the size of each measure. The relative height of each bar, as illustrated in Fig. 16 above, helps one to visualize the interrelations among the data. The second type of graph is the line graph. Here a dot is made above the base line at the height determined by each measure, and, when all the data have been so spotted, the dots are connected by short lines. This graph is usually more convenient and instructive where a considerable number of separate measures are used. Every student should familiarize himself with the fundamental varieties of graphic portrayal.

Normal Distribution Curve

The normal distribution curve illustrates a fundamental principle in biology and the way in which this fundamental principle can be visually presented. All biological traits distribute themselves in such a manner that the majority of individuals will cluster around a central measure with smaller numbers of individuals scattered about equally both above and below. When groups of biological data are portrayed by means of line graphs, the graph assumes a bell-shaped curve such as the one in Fig. 17. This curve is so common that it has been given the name "biological curve."

The biological curve is a mono-modal curve, that is to say, it has one modal or peak point. We have just said that most biological data distribute themselves according to such a curve. Another type of curve that

sometimes is found is the bi-modal curve. It does not appear in biological phenomena unless the subject of discussion is given a broad interpretation. If we are speaking of sex in general it is obvious that human beings would be portrayed on a bi-modal curve, one modal point indicating males and the other point indicating females. Preliminary studies of personality have sometimes led to the belief that personality traits are distributed according to a bi-modal curve. Thus Professor Jung thinks that introversion-extroversion is a

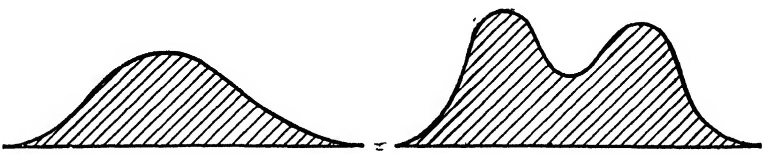


FIG. 17.—Mono-modal and bi-modal curves.

bi-modal function. Most studies of introversion-extroversion, however, seem to show that it also follows the mono-modal curve. This means that there is a large group of ambiverts with smaller groups shading off into introverts and extroverts, instead of one large group of extroverts and one large group of introverts with only a small group of ambiverts in between.

Statistical Treatment of Data

Measures of Central Tendency. Hypotheses arise through the use of mathematical procedures. Fundamental procedures include those intended to show the typical measure as based upon a large number of measurements. This typical measure is the one spoken of by

students as the average. Technically such measures are called "measures of central tendency." There are three common measures of central tendency. This first is called the *mean* and is the same as the measure commonly referred to as the average. It is found, of course, by adding up the individual measures and dividing by the number of cases.

By way of illustrating the fact that mathematical formulas need not be fearsome objects but can actually be devices to show how to carry out the process desired, the following formula for obtaining the means is given.

$$M = \frac{\Sigma M}{N}$$

This imposing formula means only that the mean M is found by obtaining the sum Σ of the individual measures M divided by the number N of all the cases.

A second measure of central tendency that is frequently used is the *median*. This is a nonarithmetical procedure. It is defined as the middle measure when the data are arranged in rank order. "Rank order" means arranging the measures in size from smallest to largest. If there are an even number of cases, the median will be the point halfway between the two middle measures.

A third measure which is sometimes used is the *mode*. The mode is defined as the measure occurring the greatest number of times; thus if you have five measures of 10 seconds, three measures of 8 seconds, and one measure of 11 seconds, the 10-second measure will be the mode.

Each of these three ways of finding a central tendency is useful in its appropriate place. The mean is best used where you want an exact mathematical statement especially where there are a large number of cases or where the data are not scattered too badly. The median is the best measure to use when there is a relatively small number of cases, especially if they are badly scattered. The advantage of the median in this case is that each measure, regardless of its size, has an importance equal to that of any other one measure. This means that individual erratic cases will have less influence than they would if the mean were used. The mode is generally used only for preliminary inspection to get an idea of probable central tendency.

Measures of Variability. It is important to know whether the data one is using are badly scattered or whether they tend to cluster around the central tendency. If data are badly scattered, it will probably mean either that the measuring methods should be improved or else that a larger number of cases must be collected than would otherwise be necessary. The easiest measure of variability is the average deviation (A.D.). To find the average deviation one first finds the average of the whole group of data. Second, the amount by which each individual measure varies from the average is set down opposite the individual measures. Third, these individual deviations are themselves averaged. The larger the average deviation the more variable the data. The degree of variability that may be permitted depends upon the preciseness demanded in the problem under consideration.

The standard deviation constitutes a more accurate measure of variability. This measure is usually used in all serious and important statistical work but is perhaps too complicated to justify its inclusion as a part of an elementary course.

Measures of Relationship. The significance of many groups of data appears only when these data are compared with other groups of data. Measures which show how one group of data is related to another are called measures of correlation or of relationship. Everyone is constantly looking for these relationships in everyday life. Much of our pseudo-psychology grows out of unjustified statements regarding such relationships in everyday matters. Such an expression as "brains and beauty rarely go together" is actually an expression of an assumed relationship. A knowledge of approximate relationships is important in a practical way. If, for instance, the statement just made were true, we would have a simple way of determining people's intelligence. All that we would need to do would be to have a committee of judges pass on the beauty of the subjects. Then we could say that all the beautiful people were dull and all the homely were intelligent. This, of course, is absurd. Science is constantly on the alert, however, to find relationships which are real and which can be used in similar practical ways.

In research work, correlation is usually computed by mathematical means. There are two formulas in widest use; the first of these, the method of *rank-order* correlation, is not difficult to learn and meets the needs of most simple problems. The formula

$$\rho = 1 - \frac{6\Sigma D^2}{N(N^2 - 1)}$$

can be learned and its use followed out by reference to any work in elementary statistics. The second and more widely used formula for correlation is that devised by Pearson called the *product-movement* method.

The Meaning of Correlation. For our present purposes it is perhaps more important that the student understand the meaning of correlation and the significance that should be attached to various degrees of correlation than that he be able to work correlation problems. When two groups of data are compared and it is found that a high score in one test is usually accompanied by a high score in the second test and that low scores are usually accompanied by low scores, we say that there is a positive or plus correlation between the two sets of figures. In the cases where high and low scores are accompanied respectively by low and high scores, we say that a negative correlation exists. Where there is no observable relationship between two sets of data, we say that a zero or approximately zero correlation exists. In statistics a perfect positive correlation is indicated by $+1.00$ and similarly, a perfect negative correlation is indicated by -1.00. Zero correlation is indicated by a .00. It is of great importance that the student remember at all times that for purposes of prediction and interpretation a given negative or minus correlation is just as significant as an equal plus correlation.

The remaining question to be considered is that of how high (either plus or minus) a correlation need be

to be considered significant. The student will find references to plus or minus correlations ranging from .20, .40, .60 up to .80, .90, or .95. Now, correlation numbers do not mean a given percentage of accuracy but are mere mathematical results which one must learn to interpret at their own face value. Figure 18 indicates graphically

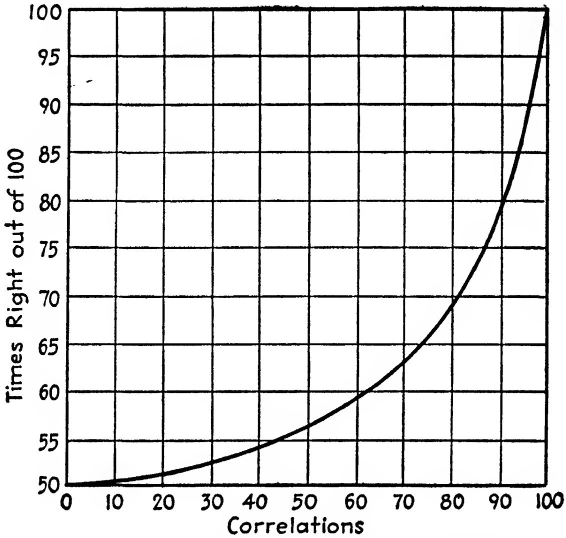


FIG. 18.—Predictive values of various correlations.

the importance that may be attached to various degrees of correlation. From this chart we learn that a correlation of + or −.50 means that judgments based on such correlations will be right an average of only 57 times out of a hundred, where chance alone would give 50 out of a hundred. A correlation of .70 means that predictions will be right only 13 times out of 100 more than they would if based on pure chance. From these facts the student will appreciate why psychologists like to insist

on correlations of at least .70 or .80. Correlations below this figure do, to be sure, indicate a slight degree of relationship, but not one great enough to be of very much help in most practical situations. Correlations for reliability of intelligence tests, for instance, are expected to be in the neighborhood of .90 if the test is to be considered satisfactory. The student should definitely familiarize these points of reference so that he may properly interpret statements found in psychological literature relating to the results of correlation measures.

SUGGESTED READINGS

CRAFTS *et al.*: *Recent Experiments in Psychology*, Chaps. 1, 2, 3.

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GARRETT, H.: *Great Experiments in Psychology*, rev. ed., Chaps. 3, 11.

PRESSEY *et al.*: *Life: A Psychological Survey*.

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Chapter 4

THE WISHES MEN LIVE BY

THE importance of motivation in understanding psychological functions has only recently been adequately recognized. Psychologists now realize that the original stimulating forces leading to action are not conditions lying outside the organism but are rather tissue needs rising inside the individual. These internal stimuli release energy which may take the form of random activity. Obvious illustrations of these motivating conditions are hunger, thirst, the sex urge, and excretory needs. The role of external stimulation is that of directing the energy thus released into appropriate channels of action.

Thus, a young baby upon being aroused by the internal stimuli resulting from hunger conditions will scream, cry, thrash about, and otherwise express the energy released in random movements. The small boy similarly stimulated will also become active. His activity, however, is more likely to be directed by such external stimuli as the smell of food cooking in the kitchen or the sight of the cooky jar on the pantry shelf.

The influence of internal stimuli in releasing action has not been determined on the basis of mere speculation. Thus, Wada was able to demonstrate the influence of the hunger urge upon bodily movement in the sleep-

ing individual. His method was to have his subject swallow a rubber ballon connected to a recording lever by means of a long rubber tube. The subject soon learned to sleep with this apparatus in position. The

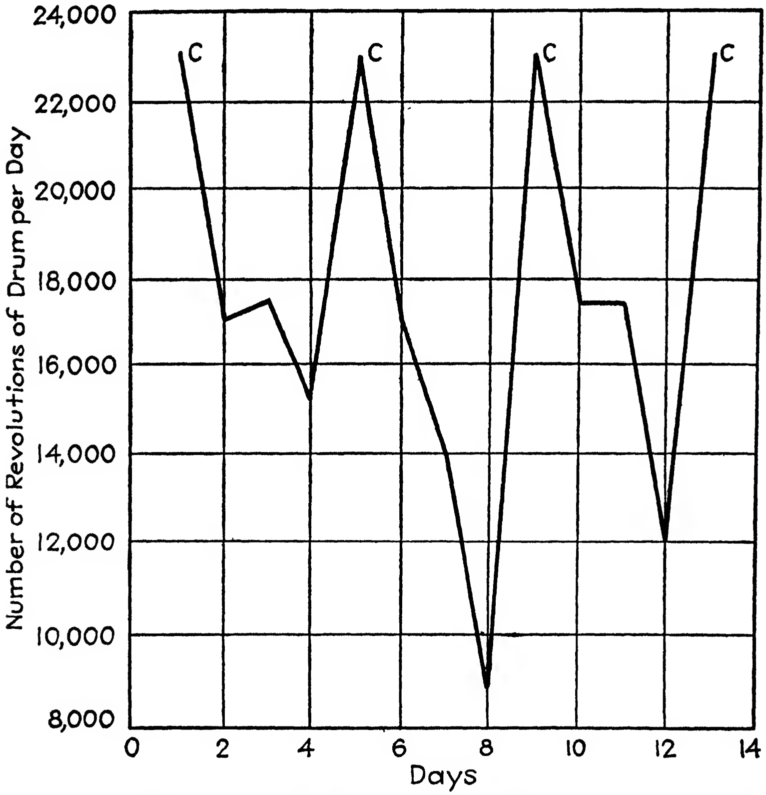

FIG. 19.—Relation between organic cycles and general bodily activity in the female rat. NOTE: "C" indicates days on which examination showed cornified epithelial cells indicating animal to be in period of "heat." (*From Wang.*)

bed upon which the subject slept was carefully pivoted and connected by levers to a second recording arm so that any movement of the sleeper would be recorded on the kymograph. Records thus obtained show defi-

nitely that, while the stomach contractions which give rise to hunger are taking place, the organism as a whole is restless and moving about.

A second study of the influence of a tissue condition upon activity was undertaken by Wang. This investigator demonstrated that tissue conditions connected with the sex urge also influence general bodily activity. His experiments were performed upon female white rats. These animals were placed in squirrel cages in such a way that each revolution of the wire wheel could be counted. Thus, the activity of a rat on a given day would be measured in terms of the number of revolutions on the wheel. In the rat, the heat cycle is a 4-day cycle. Figure 19 shows clearly that with the recurrence of the heat cycle, there is a marked increase in general activity on the part of the rat.

This objective evidence of increased activity resulting from the sex urge could be paralleled by instances in the human field in which increases in socially directed activity can be traced to the love motive. Thus, the young man who works in an office in the daytime and studies assiduously in the evenings at night school so as to win a promotion which will permit him to earn enough money to marry is actually exhibiting increased activity in terms of sex stimulation.

Methods of Measuring Urges in Animals

A realization of the importance of internal stimuli in motivating human and animal behavior has led to much experimental work in measuring these urges. Two principal measures have been devised. The method of choice

provides a measure of a given urge relative to the strength of another urge.

In measuring the strength of the hunger and sex urge in rats, for instance, a cage is devised so that the experimental animal can be placed in the middle compartment with food in one compartment and an animal of the opposite sex in the other. The experimental data will be the number of times the animal approaches each of these compartments. This type of situation frequently operates in the case of humans. Thus, a man may have an urge to purchase a new motorcar and, at the same time, an urge to take a trip abroad. If his funds are insufficient to do both, he will choose, of course, the one representing the stronger urge.

The method of choice has the difficulty, however, that it does not reduce the strength of urges to a standard scale for all urges. Such a standard scale for measurement is obtained by the obstruction method. In this setup, the experimental animal is placed in one compartment while the object of the urge to be studied is placed in the other. Connecting the two is a runway which is provided with an electrically charged grid. The strength of the urge studied can be measured in terms of the number of times the animal will take the punishment involved in crossing the grid, or it may be measured in terms of the current which the animal will stand in crossing. In this way, the strength of any of a number of urges can be calibrated on a uniform scale.

An interesting point of speculation has long been the question as to which of the two basic urges, hunger and sex, is the stronger. Someone has coined the expression,

"Sex and hunger rule the world." Hunger refers to a basic need from the standpoint of the maintenance of the individual, whereas sex is related to a basic function from the standpoint of maintaining the species. The long argument as to which of these urges is the stronger has come to a rather abrupt end in so far as animals are concerned through the application of the above described experimental procedure. Warden, Valentine, Moss, and others have all conducted experiments, and in every case the results have been the same. When each urge has been calibrated for its maximum intensity, the hunger urge has proved to be the stronger. Valentine discovered that the male white rat will cross the charged grid an average of 13.4 times in response to the sex urge and 19.1 times in response to the hunger urge. The female rats in the same group of data averaged 14.1 crossings in response to the sex urge and 19.0 times in response to the hunger urge.

The relative strengths of a number of urges have been determined by Warden and his associates. With each urge at its greatest intensity the average number of times rats would cross the charged plate of the obstruction box was determined. The list below shows the relative strength of several urges studied.

URGE	AVERAGE NUMBER OF CROSSINGS
Maternal	22.4
Thirst	20.4
Hunger	18.2
Sex	13.8
Exploratory	6.0
No incentive	3.5

Another problem related to the question of urges is that of the increase and decrease of the urge with the

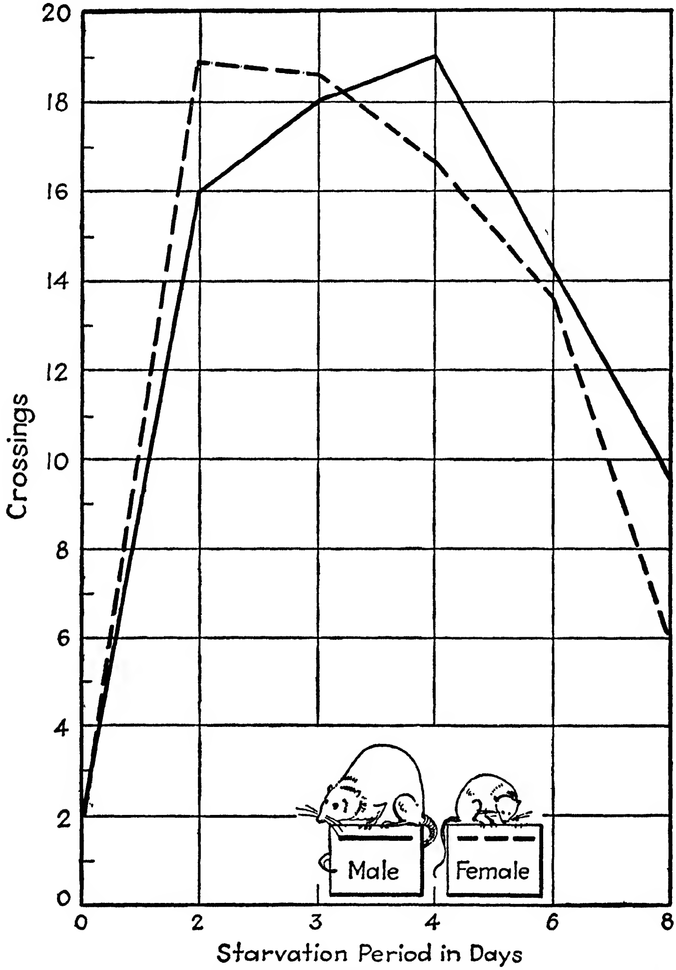

FIG. 20.—Relation of the hunger urge to length of the starvation period. (*Adapted from Warner.*)

passage of time. Persons who have fasted long observe that the desire for food does not increase progressively

as the fast is prolonged. Experimenters again have reduced this matter of change in the strength of urges to quantitative figures. The graph (Fig. 20) shows the change in the strength of the hunger urge in the white rat as indicated by the number of crossings the animals made on successive days. It will be noted that the urge appears to reach its maximum at the end of 2 days for the female rat but does not reach its maximum for the male rat until 4 days have passed. In each case, the strength of the urge, as thus measured, drops away rapidly after these periods.

Basic Organic Urges

A study of the human situation shows that activity originates from certain bodily needs. These needs are for the most part common to both humans and animals. The method of satisfying these needs among humans is unique, however, and indeed will vary greatly from group to group. Gates has pointed out that all habits find their origin in these basic bodily cravings. It will be well then to have in mind the more important of these urges. They are (1) the urge to obtain food and drink when hungry and thirsty, (2) the urge to secure air (this urge, which is not commonly recognized, requires only a momentary blocking to reduce the human to a primitive struggling animal), (3) the urge to secure a favorable bodily temperature (coolness and warmth), (4) the urge to secure rest and sleep, (5) the urge for action, (6) the urge to avoid pain, (7) the urge to satisfy sexual demands.

A great deal has been written on the methods of satisfying these urges and on the evil consequences resulting from persistent failure to satisfy them. The whole Freudian psychology (psychoanalysis) is based upon a consideration of the frustration of the sex urge. In a nontechnical way we find that practically all our novels and movies find their basis in this same problem. Many of the most pressing sociological questions growing out of our changed and industrialized way of living relate to problems of marriage, child raising, and other questions dealing with the regulation of the sex urge. Although the taboos and regulations governing the other urges are frequently less drastic and are less frequently brought to our attention, it nevertheless remains true that each of the afore-mentioned urges has developed around it a whole set of social habits. The problem of psychological adjustment itself is pretty much a question of working out ways of satisfying those urges that are socially and personally acceptable.

Persistent Nonadjustive Reactions

It often happens that an animal or human being becomes pretty well settled in one habit of solving a blocked urge and equally conditioned to avoid others. When this learned adjustment becomes blocked, the animal may fail even to attempt to employ another solution. In this event the animal may remain completely inactive or, if forced, frantically go through its old and unsuccessful routine. In some instances the animal may burst into a violent series of random and meaningless activities ending up in a convulsive attack.

When matters have come to this pass in humans, we say that the patient has suffered a nervous breakdown or, in extreme cases, even that he has become insane.

Some extremely interesting light has been cast upon the problem of nonadjustive behavior by Maier, who placed rats in situations closely duplicating frustration conditions found among humans. In one experiment a rat was taught to jump from a platform to a door marked by a black circle, which would open and let the rat to its cage or to food. Beside it was a door marked by a white circle which when jumped at would not open. After the rat had been thoroughly trained to jump always at the black circle regardless of where it was placed, the experimenter suddenly changed the setup so that the door behind the black circle was locked and the one behind the white circle was unlocked. After the rat had been forced to jump a few times and was bumped against the black mark, he began to show extreme nervousness and usually either went into a coma in which he could be manipulated but would not move by himself or else showed the wild convulsive action of which we have spoken. The matter went so far that even if the white door were left open, the rat would still refuse to jump through it, but would, if forced, continue to jump against the black circle beside the open door. This experimental demonstration of the mechanism leading to nervous breakdown and insanity is strikingly illustrated in a motion-picture film that Maier has prepared. Some interesting practical applications of this situation in modern personal and industrial life have been made by Hayakawa in his important little book, *Language in*

Action, Chap. 14, entitled "Rats and Men." In this chapter Hayakawa urges that we take a lesson from the rat and try to avoid its errors through keeping away from too rigidly determined adjustment patterns. He suggests that the chronic conservative and the chronic liberal are alike liable to this persistent nonadjustive action in that they may refuse some of the most obvious solutions to problems just because they lie outside their self-imposed sphere. In another illustration, Hayakawa shows how the mutual resistance of the industrialist and his employees leads to an increasingly bitter struggle ending in riots, tear gas, and possibly deaths. Here a greater flexibility of thinking might have lead to a more satisfactory and less painfully arrived at solution. In a similar way, the true scientific attitude is pictured as a perpetual readiness to modify one's mode of attack and to adopt some new course of action when the old routine ceases to work. In other words, a part of the scientist's mental make-up should be a refusal to accept the truth of a proposition merely on the basis of its being held by a great many people or being noisily expounded by a lesser number. In short, he does not accept the idea that "Fifty million Frenchmen can't be wrong," for, indeed, we seem to have had ample evidence recently that either they or their leaders can be!

Capitalizing on Urges in Selling

Underlying all salesmanship is the problem of motivation. The fundamental task of the salesman is to arouse an urge or desire on the part of the buyer. Our own studies in motivation will help us to understand this

problem. The urges most universally available for sales appeal will be those urges that are chronically unsatisfied. There are three important situations which, as we have seen, result in human urges being unsatisfied. They are obstacles in the environment, antagonistic urges, and social conventions. We have already seen that social conventions account for the almost universal blocking of the sex urge in Western civilization. It is for this reason that this urge has come to be so widely used as an "attention getter" in modern advertising and selling. The businessman can be pretty sure that this urge will be inhibited to a greater or less extent in all his potential buyers. If he can arouse it and attach it in some way to his goods, he can be very sure of having made the first and most important step toward a sale. Advertising men call this process of attaching some urge to their goods "transfer of approval." Sometimes this process is carried to ridiculous lengths. An example of this is to be found in a cigarette advertisement in which the lead line was "make this test." Below this was a picture of a man and woman embracing each other. The subtitle said, "Keep kissable with Old Golds." The advertisement went on to say that the test consisted in opening a pack of Old Golds and examining the tobacco. The obvious implication of the advertisement, however, tied the test that was to be made up with the apparently agreeable act of kissing. Frequently such associations are so crude and flagrant as to be nauseating to a person of refinement. Such procedures do, nevertheless, have the desired effect as has been shown repeatedly by studies of the effect of the use of sex appeal upon sales.

TABLE 8

Effect of Change in Title on Sales

OLD TITLE	YEARLY SALE	NEW TITLE	YEARLY SALE
The Tallow Ball	15,000	*A French Prostitute's Sacrifice*	54,700
Fleece of Gold	6,000	*The Quest for a Blonde Mistress*	50,000
The Mystery of the Iron Mask	11,000	*The Mystery of the Man in the Iron Mask*	30,000
The King Enjoys Himself	8,000	*The Lustful King Enjoys Himself*	38,000
None beneath the King	6,000	*None beneath the King Shall Enjoy this Woman*	34,000

The publishers of the famous 5-cent Little Blue Books conducted such a study. Whenever the sales on any title in their series fell below 10,000 copies annually the book was sent to the "hospital" where its name was doctored so as to have greater appeal. The effect on sales of the change in titles from a nonsuggestive one to a suggestive one is shown in Table 8.

Types of Appeal. The various forms of human urges have been classified under five heads which are thought to include most of them in their socialized form. These five human desires are:

1. The desire for wealth
2. The desire for worship
3. The desire to be sexually attractive
4. The desire for health
5. The desire for power

Each of these desires lies at the basis of a different type of human exploitation. Once the desire is sufficiently aroused, the individual's sales resistance will pretty largely vanish. In spite of being repeatedly stung, we go on falling for get-rich-quick schemes. Fake promoters flourish today almost as well as they did in

the days of "get-rich-quick Wallingford" or of the stock-market boom in 1929. False prophets flourish today as they did in the days of the Crusades or in the days of oracles of ancient Greece. Revivalists, spiritualists, and psychic advisers can be found by the score in any city of size. The desire to be sexually attractive forms, as we have suggested, the core of the whole program of human exploitation. Everything from soaps and gargles for people "whose best friends won't tell them" to fake glandular extracts for restoring youth are included under this heading. Several interesting books have recently been published dealing with the quackery of cosmetics and other beautifiers. The excellent book, *Skin Deep*, deals entirely with fraudulent practices and fake products sold at fancy prices in the one field of cosmetics.

The desire for power opens a remunerative field for exploitation of those who would like to attain a magnetic personality overnight or to become masters of some musical instrument or to have the power to speak effectively in five easy lessons, or of those who seek some inside route to motion-picture producers or to the higher-ups in business. Most tragic of all, perhaps, is the exploitation related to the desire for health. Millions of people with real or imagined ills squander untold fortunes annually on fake cures. The only result of these is that if the ill be real it probably gets worse, whereas if it was imaginary, it frequently becomes real as a result of the alleged treatment. The American Medical Association is spending many thousands of dollars annually combating this evil. In connection with this program they have

published some excellent volumes under the name *Nostrums and Quackery.* In addition to these volumes several other popular books on the subject have appeared recently and should be read by interested students. Outstanding among these books are *Your Money's Worth* by Chase and Schlink and 100,000,000 *Guinea Pigs* by Kallet and Schlink.

It is a tragic fact that modern selling operates on the psychological principle of arousing desires rather than on an appeal to reason. Salespeople argue that high-pressure sales methods increase the output of goods and hence reduce their cost. It can hardly be denied, however, that much of the waste of modern advertising could be avoided if advertising took the form of simple, direct, and scientific statements of the quality of goods rather than the present form of emotional appeal.

The Dynamics of Personality

Several of the personality views that we shall consider are characterized by an emphasis on the motivating forces that lie behind behavior. For instance, according to Freud, the driving power of sex lies behind much of what a living creature does and determines many of the complexities of human personality. Practically all psychological thinking recognizes the importance of motivation. Two of the most widely accepted views of motivation have been (1) the instinctive position of McDougall and (2) the position that finds that motivation arises from internal bodily conditions, or "tissue needs," as they are frequently called.

Both the foregoing interpretations have been criticized, especially by G. W. Allport, on the ground that both concepts are too inflexible to account for the wide variety of highly motivated behavior found in humans. Allport feels that it is straining the point to argue that all our complicated personality functions are carried out merely to satisfy some basic hunger, sex, or other tissue need or to satisfy some one of a group of instinctive cravings.

Functional Autonomy of Motives. Any psychology that concerns itself with motivational problems may in a sense be said to be dynamic. But Allport feels that only in the concept that he has labeled "functional autonomy" do we find an explanatory system that covers the wide variety and apparent independence of motives as found among humans. He finds, in the statement made by Woodworth in his *Dynamic Psychology* that "every mechanism is a drive," the explanatory principle needed. It is true that original motivation may spring from tissue needs or even, according to some thinkers, from instincts; but what happens is that in the process of satisfying these urges the animal engages in a rather wide range of trial-and-error action. Now some of these lines of action may be repeated even though they do not immediately satisfy the urge that gave rise to them.

The position of Woodworth and Allport is simply this: that any such learned habit of action generates its own motivation. Other things being equal, we like to do things that we have done. Thorndike in his Law of Readiness carries much the same thought when he says, "For an organism that is ready to react, to react is

pleasant." The reader will perhaps be able to think of many instances in his own experience in which he started to learn some new and fairly complicated activity and perhaps found it tedious at first but presently, upon having developed a fairly good skill, discovered himself carrying out the activity for the sheer pleasure of doing it. The pleasure thus derived is held to be no less keen just because the original motivation is no longer operating. For instance, the pleasures of fine dining certainly extend far beyond the motivation of the hunger urge. Even lower animals have been shown by experiments to be willing to continue or to begin eating activities even though the hunger urge is not present. These studies show that our drives are autonomous, that is to say, independent of their possible sources and dependent only upon habits or groups of habits that are being set up "ready to go."

Much of the maladjustment that comes with increasing age results from the fact that some of our most deep-seated habits are forcefully broken up for us. As the friends of elderly folks die there is left a very real gap in the sense that the activities that were carried on with those friends can no longer be performed. In the same way when a married couple's children grow up and leave home there is the all too familiar feeling of emptiness resulting in a difficult period of adjustment while new habits are being set up to fill in the gaps left by the old.

That the mere doing of an act enough times can cause it to acquire such a wealth of motivation as to blind one to its actual importance or even to its truth has long been known. Pascâl, the famous French philosopher,

once pointed out that if one does not feel like praying one should first start walking to the church; if one still does not feel like praying one should enter the church; next, one should kneel, and, finally, one should move one's lips as though one were praying. The truth that Pascal realized is that if one does this often enough one will come to place a value upon prayer and will thus actually have developed that part of religion within himself.

That this mechanism can also work toward the acceptance of lies or other undesirable social ideas is well illustrated by the following actual case study of the influence of Nazi propaganda on an intelligent person:[1]

> The daughter of a liberal professor, "Aryan," in her middle twenties when Hitler came to power, was teaching "current events" at a large urban school. Although she had been used to drawing on a wide range of newspapers for her classroom presentation, foreign as well as German, under pressure from the Nazi Teachers Union, of which she perforce became a member, she was "instructed" to confine herself to versions of the news presented in the Party press.
>
> At first [she said] I just made myself do it. The Nazi accounts were so fantastic—plots of World-Jewry, etc.—that I could hardly keep from laughing as I read them; but of course I had to be careful. It was somewhat of a shock to find how readily the children accepted these Nazi fabrications. *But the most amazing thing of all was that after a few years of going through the routine, I began to believe the stories myself* and could no longer distinguish in my own mind between propaganda and truth."

The concept of the functional autonomy of motives is here seen to be a factor of vital importance in contemporary Western civilization. It underlies and ex-

[1] HARTSHORNE, E. T., *German Youth and the Nazi Dream of Victory*, No. 12, p. 19, Farrar & Rinehart, Inc., New York.

plains the ability of a Hitler to use propaganda and other mass education techniques to transform a people long famed for their stolid levelheadedness and loyalty to the cause of intellectual integrity into a nation of emotionally disturbed and vengeful people who find their satisfactions in the abuse of racial minorities and in rantings against the societies they themselves accepted in their calmer moments. There can be no doubt that the same fundamental urges motivate the present nonintellectual, hysterical, and cruel-minded Nazi citizens as motivated the German people a generation or two ago when they had made themselves known as one of the world centers for general cultural and scientific integrity and advancement. This tragic lesson of the possibility of personality distortion through propaganda should always be before us. If we remember with Woodworth that every mechanism (habit) carries with it its own drive, we shall perhaps be reenforced in our appreciation of the importance of proper education and a wholesome social environment in building personalities adapted to civilized living.

Thomas's Four Wishes

We have seen that the motivating forces in human life tend to become divorced from the original simple biological needs. This is because the satisfaction of our biological requirements is achieved through social action. Social life is so complicated that we soon come to strive, not for a thing itself, but for something that will enable us to obtain what we want. Thus a man nowadays seldom works for bread and butter directly but works instead for money, which can be used to obtain

food. In the same way in the field of sex he does not picture his romantic attachments as simply the satisfaction of the sex urge but rather thinks of them in such general terms as courtship, marriage, family, and social responsibility.

W. I. Thomas has devised a useful classification for the basic wishes that motivate modern man. His classification has the advantage that it deals with generalized wishes, each of which covers a whole host of specific wishes. It is this generalization that makes his classification useful in considering some of the complexities that grow out of man's social struggle. Let us consider each of these four wishes in order. The wishes are:

Security
Recognition
Adventure
Response

Security. Under the term security are included all wishes relating to the maintenance of the basic biological necessities of life. By security we mean the attainment of food, clothing, and shelter, and a reasonable hope that our activities will continue to provide these in the future. It is this last point that is perhaps most important in considering the neurosis that grows out of a feeling of social insecurity. Many heads of families grow gray prematurely, not because they have not enough food in the house for today, but because they have learned through observation to fear that 6 months from now there will be no food. Here we have illustrated the theory that a wish is a satisfaction symbolized in ad-

vance. A man may suffer the effects of want through reciting to himself such symbols as foreclosed mortgages, lost jobs, and the poorhouse, quite as much as he can through going to the cupboard and finding it bare.

Since the wishes related to security are absolutely essential to the maintenance of life itself, it follows that activities related to gaining security will be the most powerfully motivated of all. In only rare instances will a man be led to deeds of violence unless his own feeling of security is threatened. Many instances of race violence can be traced to the fact that the oppressors feel in the presence of the oppressed a threat to the security of their own social position. Unprejudiced observers quite freely recognize that the antagonism to the Jewish people in Germany arose from the fact that the Jewish people were gradually "freezing out" the so-called "Nordics" from many of the most desirable professional posts in law, medicine, government, and universities. Even in our own country, some universities have already begun unofficially to limit the enrollment of Jewish students, particularly as regards those who may be eligible for such things as scholarships and other honor awards. The almost universal opprobrium that has been heaped upon the Jews, in connection with their money lending and mercantile work, is obviously another rationalization of Gentile concern over the fact that the Jewish merchants frequently outsmart them in business.

The case of the itinerant laborers in California illustrates the same mechanism. The large landowners desire the cheap labor of the itinerant workers to obtain the security, *i.e.*, profits, in connection with getting their

fruit in on time. Once the fruit is out of the way, however, the presence of those whom the landowners call "Okies" constitutes a real or imagined menace to the security of the landowners for the simple reason that the "Okies," if they remain in the community, exercise a certain amount of control through the ballot and may force the passage of legislation that would add to the expense, *i.e.*, reduce the security via profits, of the landowners.

In all societies that exist at a marginal level, the urge for security is bound to be dominant. Since practically all societies so far have been operating at this level, we have come to take it for granted that the urge for security is and must be the chief motivating force in life. Various writers of "Utopias" have painted pictures in which the urge for security either will no longer exist or will be made a secondary matter. We shall have occasion to consider this possibility in greater detail later.

Recognition. The wish for recognition is probably closely related to the desire for security. In actual practice most people desire to be looked up to because it makes them feel more secure. Naturally the strongest dog is most likely to get the bone; and, if other people look up to you, it must mean that they consider themselves as being in some way inferior to yourself, in which case you may be spared the actual struggle for your desires, since your associates will give up to you without a struggle. Many writers, such as Bertrand Russell in his recent book, *Power*, make a case for the point of view that the desire for power is a natural and fundamental part of man's nature. It is true that it is hard to recog-

nize any form of social interaction in which the idea of better and worse, superior and inferior, does not come out, especially so long as individual differences in our various capacities exist; but at the same time it seems to many, including the present writers, that these drives for recognition would be much less insistent and perhaps almost nonexistent if they were not propelled by the dire necessity of a struggle for security. Dictators quite generally seem to show this mechanism in their struggle to maintain the recognition of their constituency. The more shaky their position becomes, the more drastic are the measures they employ to force an adulation of their public, for without this public acclaim their own personal security could not be long maintained.

Adventure. The desire for adventure or new experience presumably springs from a psychological source different from that of the wishes just described. Thorndike was one of the first to point out that when an organism is rested it tends to engage in spontaneous activity. Many other psychologists have commented on the random excess activity of young animals, both human and subhuman. Watson was one of the first to study the way in which these "spontaneous excess activities" gradually become crystallized into the various routine habits of daily life.

Boredom may result when one possesses a greater abundance of energy than that required to carry on the activities. It also comes with a situation in which the present activities, though time-filling, are not sufficiently exacting, in the sense of requiring large expenditures of nervous energy, since they have already long

ago become habitual. It is this tendency, then, to seek new kinds of action, in addition to more of the same action, that Thomas means by the wish for adventure or new experience. Probably one of the most unique aspects of man is the predominance of this desire, and among the characteristics of old age is the waning of free nervous energy to the point where the individual ceases to seek new activities and becomes satisfied with his stereotyped daily behavior. An idealistic view of social life envisages an extension of man's ability to engage in adventuresome pursuits through reducing those drains on his energy growing out of his struggle for existence. Actually, however, society tends to frown on adventure as being needless risk-taking and hence likely to upset the smooth running of our social machinery, while at the same time, though without seeing the connection, society lauds those persons who engage in creative activity, which of course is nothing more or less than engaging in mental adventures.

Response. The desire for response differs from the desire for recognition in the important fact that in response we ask only the presence and mutual participation of another without desiring them to look up to us. The sexual aspects of our lives in their finest form are perfect illustrations of the urge for response. The true lover does not desire that his loved one admire him but merely that she be present to participate with him in the adventure of living. Because we live in a struggle society, it is true that very often the desire for recognition is substituted in situations in which the desire for response is normal. Thus many persons who are frus-

trated in their search for recognition in other fields turn to the field of love and seek there merely someone who will look up to them and bolster their shattered ego. Many a businessman or clerk who is mouselike in his business relations becomes a raging lion as he returns to the bosom of his family. Fundamentally, then, one might think of response as involving the same spontaneous and unforced outpouring of human energy in the field of personal relationships which adventure offers in the field of gross physical activity of a more individualistic sort.

The writer has recently been collecting data on the amount of emphasis placed on each of Thomas's four wishes by college students with different professional objectives. The interest inventory (adapted from Lewerenz) asks the subject to rank his preferences for each of four activities. Each of the activities stresses one of Thomas's four wishes. Thus a person who states that he desires to live a thrilling though dangerous life would have adventure as a primary interest, whereas one who desires to be noted for having followed time-proven methods would exhibit the desire for security. A person whose interest was in being an active Community Chest worker would show a desire for response, whereas a person who had a desire to be the subject of a successful biography would thereby show an interest in recognition. By questions of this type it is possible to get an interest profile based upon the student's percentile ranking in each of the four wishes.

Preliminary studies show that students in general have a stronger interest in adventure than in any other

wish. This is perhaps to be expected among younger persons. With relation to occupational interests, it does seem possible to present characteristic occupational profiles. For instance, as shown in Fig. 21, medical

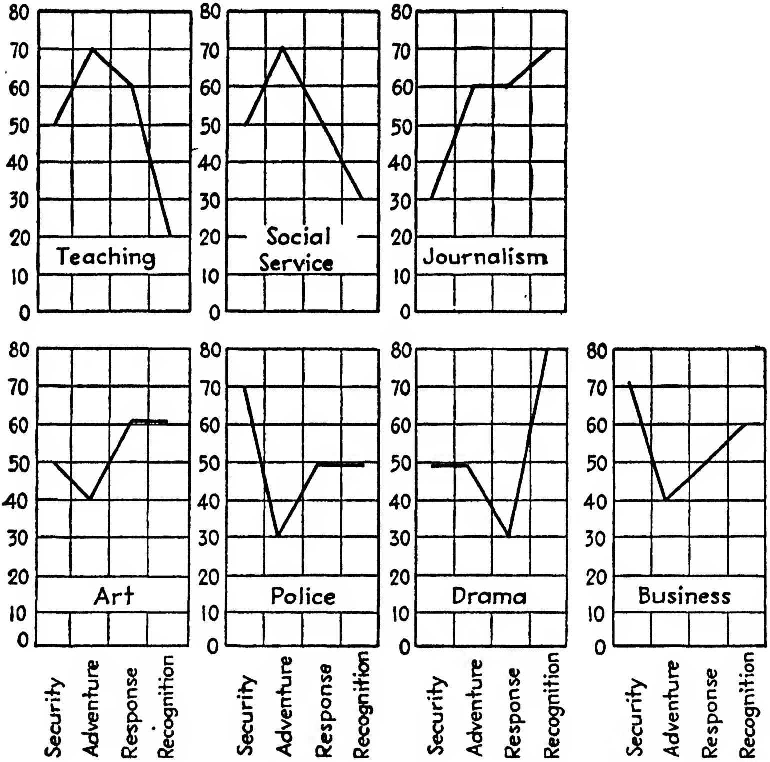

FIG. 21.—Interest profiles of students with various vocational objectives.

and social service students show profiles very much like that of a teacher. These groups show a high interest in adventure and a low interest in recognition. Business students, on the other hand, exhibit a strong interest in security and recognition with less of an urge for adventure. Music and art students show that their

strongest interests are for response and recognition. An interesting preliminary result has been found in a study of candidates for police positions in that these students show a stronger urge for security than for any other wish. Security in this instance, of course, is being sought in the form of the Civil Service positions rather than being thought of in terms of the occupational hazards of being a policeman. These results are purely tentative at the present time but are interesting in that they point out a possible mode of attack upon problems of the relationship between personality and occupations.

SUGGESTED READINGS

ALLPORT, G. W.: *Personality*, Chap. 7.

ELLIOT and ELLIOT: *Solving Personal Problems*, Chap. 9.

HAYAKAWA, S. I.: *Language in Action*, Chap. 14.

MORGAN, J. J. B.: *Keeping a Sound Mind*, Chaps. 7, 8, 9.

THORNDIKE, E. L.: *The Psychology of Wants, Interests and Attitudes.*

VALENTINE, W. L.: *Experimental Foundations of General Psychology*, Chaps. 9, 10.

WARDEN *et al.*: *Animal Motivation.*

WHITE, W.: *The Psychology of Dealing with People*, Part III.

WOODWORTH, R. S.: *Dynamic Psychology.*

Chapter 5

THEORIES ABOUT PERSONALITY

THE word personality is derived from the Latin, *persona,* meaning mask. *Persona* in turn is derived from the Greek language. In the ancient Greek plays many actors wore masks denoting the role they were playing. In modern times actors make their roles obvious, not by wearing a mask, but by exaggerating the traits and expressions that are commonly accepted as going with a given role or occupation. The present popular concept that personality is a kind of "false front," which one dons when on good behavior and which may not correspond to one's true inner self, is thus a fairly literal outgrowth of this original usage. Some psychologists still use the term personality in this limited sense, but most psychologists use it to refer to the more basic and individualized aspects of one's make-up. Objective psychologists are likely to think of personality as being the sum total of one's actions, although they would immediately have to admit that the way in which one's actions affect other people is determined, in part, by one's physical structure. In addition, some of these men, such as Allport, whom we shall discuss shortly, and Tolman, insist that one's immediate behavior cannot be properly evaluated in a personality sense unless one considers also the purposes or goals toward which such action aims.

The meaning of the term personality together with an understanding of some of the points of emphasis in its interpretation can best be gained through a brief consideration of the personality views of our outstanding psychologists. Such a study will certainly enhance one's general "cultural background," since their views, especially those of the psychoanalysts, are a part of the daily intellectual fare of many people and underlie much of our current literature.

Now, in all the personality types that we shall study, it should be borne in mind that men in general fall into a moderate or mid-point position with regard to any given set of traits. Thus, most people will react in an ascendant fashion in certain cases but submissively in others, as the situation may require. This, of course, is merely the part of wisdom. The most pugnacious individual usually adopts a conciliatory attitude when the motorcycle officer pulls alongside with his siren blowing. Even the classic picture of the submissive type, as shown by the cartoonist Webster in his character Mr. Milquetoast does on occasion flare up to an "expression of rights."

Students of personality theories have, like those in the field of intelligence, been bedeviled by the old question as to the relative importance of hereditary and environmental factors. Psychological theory has vacillated between a strong insistence upon the importance of hereditary factors, as exhibited in the older theories of instinct, and contemporary views, which tend fairly strongly to emphasize environmental influences. Our purpose is not, certainly, to add fuel to the flame of this controversy but rather to show that an intelligent view

of personality need not await its solution. Even Benedict, who is a strong environmentalist, points out that although "the biological bases of cultural behavior in mankind are for the most part irrelevant [this] is not to deny that they are present."[1] Among psychologists much credit belongs to F. H. Allport, who in his *Social Psychology* showed that personality is a complex product of such hereditary factors as height, weight, and degree of maturation, plus the environmental factors of the social experiences to which the organism is exposed. As he put it, personality is a product of maturation plus experience. In the discussion that follows we shall have occasion to utilize theories of both hereditarians and environmentalists. In fact it will be a part of our purpose to show that these theories can be harmonized in working out a practical understanding of human personality.

Personality Classed According to Psychiatric Types

Rosanoff, in his *Manual of Psychiatry*, has developed a theory of personality based upon psychiatric observations. Rosanoff gives credit to Pavlov for originating the theory that personality is grounded in certain constitutional temperament traits. Pavlov in turn came to this view as a result of his extensive work on the conditioned reflex in dogs. Pavlov found that his dogs could be classed into three main groups, *viz.*, those that showed a high degree of excitability, those (the inhibitory group, as he called it) that were very much self controlled, and a central or normal group. Pavlov held that these differences in a dog's fundamental temperament are deter-

[1] BENEDICT, RUTH, *Patterns of Culture*, p. 236, Houghton Mifflin Company, Boston.

mined by heredity. Applying this line of thinking to the human field, Rosanoff proceeds to a study of "hereditary temperamental traits" in humans. According to his most recent work there are "three great groups of constitutional mental disorders in the etiology of which hereditary factors seem to play an important part."[1] These groups are chaotic sexual make-up, affective-reaction, and antisocial manifestations. In our own study of the psychiatric view of personality we shall retain the older and more conventional classification of the psychiatric types, particularly since the most important personality test to be based upon this theory utilizes the formal classification. The Temperament Scale referred to is that devised by Humm and Wadsworth, who interpret Rosanoff's theory as follows:

Each group of traits dealt with is regarded as a component of temperament. Diagnosis consists of identifying the component or components which appear to predominate or to be emphasized in the temperament make-up of a given subject. Analysis of temperament requires measurement of each component present, whether manifest or latent.

The components are listed below with the symbols used to identify them in the temperament scale and with the constitutional mental or nervous disorder in which an extreme degree of each is typically observed.

COMPONENT		SYMBOL	DISORDER IN WHICH OBSERVED
1. "Normal"		*N*	
2. Hysteroid (or antisocial)		*H*	Hysteria, criminalism
3. Cycloid	*a.* Manic phase	*M*	Manic-depressive psychoses
	b. Depressed phase	*D*	Involutional melancholia
4. Schizoid	*a.* Autistic phase	*A*	Dementia praecox
	b. Paranoid phase	*P*	Paranoiac conditions
5. Epileptoid		*E*	Mental disorders allied with epilepsy

[1] ROSANOFF, A. J., *Manual of Psychiatry and Mental Hygiene*, 7th ed., p. 659, John Wiley & Sons, Inc., New York.

1. The "normal" component is primarily a control mechanism, providing rational balance and temperamental equilibrium. It underlies the conservation and conformity to socially acceptable conduct observed in the well-adjusted subject. Essentially a "brake" or "balance wheel," the normal component presents mainly characteristics associated with restraint, and persons in whom it is overaccentuated may be given to indiscriminating conservatism. In diagnosis, the term "normal" is rarely used alone except for such ultraconservatives. It is generally used in combinations such as "normal-cycloid," "normal-schizoid," etc., where it refers to individuals whose temperaments are under control, and who are essentially well adjusted but who also show a large degree of cycloid or schizoid temperament.

Our use of quotation marks with the term "normal" is for the purpose of connoting the special meaning attached to that word in our discussion of its application in the test and in the theory of temperament upon which the test is based.

2. The hysteroid component is concerned essentially with self-preservation. An individual with an excess of this component possesses a character defect with ethically inferior motivation, manifested by malingering, stealing, lying, cheating, and similar antisocial behavior. A moderate degree of hysteroid tendency underlies much of our prudence, shrewdness, and diplomacy, and may even contribute to social adjustment, since socially acceptable conduct often serves the ends of self-interest.

3. The cycloid component is characterized by emotionality, fluctuations in activity, and interference with voluntary attention. The manic phase is manifested by some degree of elation, pressure of activity, and distractibility, together with such manifestations of excitement as jests, pranks, enthusiasms, impatience, etc. The depressed phase is manifested by some degree of sadness, lessened activity, dearth of ideas, and associated characteristics such as worry, timidity, feeling of malaise, and the like. The manifestations of a general cycloid nature are fluctuations from emotional equilibrium, hotheadedness, difficulty in sleeping, etc. Cycloid subjects are enterprising, sensitive to social situations, versatile and sympathetic. They are handicapped by such tendencies as emotional thinking, lack of persistence, changeability of mood.

4. The schizoid component is characterized by heightened imagination. It leads to a tendency toward a daydream life, concerning which the subject is sensitive. The autistic manifestations are seclusiveness, shyness, suggestibility, and the like, accompanied by an ability to visualize and to concentrate on special tasks, excluding diverting interests. The paranoid manifestations include stubborn adherence to fixed ideas, conceit, suspicion, and contempt for the opinions of others, with behavior fitting these traits. In the presence of sufficient "normal" component, the paranoid phase is of value in pushing through programs which meet with resistance.

5. The epileptoid component is characterized by inspirations to achievement which are meticulously developed and pushed through to completion. It causes the subject to spend endless time in working out projects and yet, at times, to appear inconsistent because of some contradictory inspiration. The inspirational tendency is often of a religious nature. There are sometimes explosive temper manifestations, often occurring on slight provocation, after long periods of endurance. Some physiological symptoms associated with epilepsy, as well as epilepsy, are likely to be present or to appear in history.[1]

Now if personality can be shown to cluster around these central concepts, it should be possible, by means of an adequate test, to determine which of the components is predominant in a given individual. If we can do this, we can assist the individual in gaining a more satisfactory insight into his own nature, can help him to select a type of lifework which will be congenial for him.

Humm-Wadsworth Test. Such a test has been developed by Humm and Wadsworth who have constructed a questionnaire based upon Rosanoff's theory of personality. This questionnaire aims to discover which of the above listed personality components is predominant in

[1] Quoted by permission of the authors.

any given individual. It proceeds by the method of obtaining the subject's reactions to a large number of carefully considered social situations.

In the construction of personality tests, as in all test building, the most important and most difficult problem is that of validity. A valid test is one that measures what you think it measures. This can only be determined in terms of a valid criterion. In other words how do we know that answering a given question means that a person has a tendency toward the hysteroid or cycloid personality? The great advantage and the main strength in the Humm-Wadsworth test is that it has been worked out in terms of what is probably as good a criterion of validity as it is possible to have in the field of personality work. These men have carefully validated their questionnaire upon hundreds of psychiatric cases found in state hospitals. This means that each of the subjects used in the validation has been attested by at least three psychiatrists to be a given type of psychopathic case. The judgment of these psychiatrists is in every case, of course, the result of a careful analysis and a long case history and is arrived at only after careful clinical observation.

The *Humm-Wadsworth test* consists of 320 questions relating to actual experiences or attitudes that may have become predominant in an individual's life. They have been so balanced and weighed that it is possible, by means of the questionnaire, to determine the proportional significance of each of the above mentioned personality components in a given individual's life. One of the most important discoveries that have grown out of

their work is the demonstration of the fact that most personalities have some of many or all of these components but that usually one or more of them will be found to predominate. In some cases, however, none of the characteristics predominates except that of normalcy. Where normalcy predominates and the others are

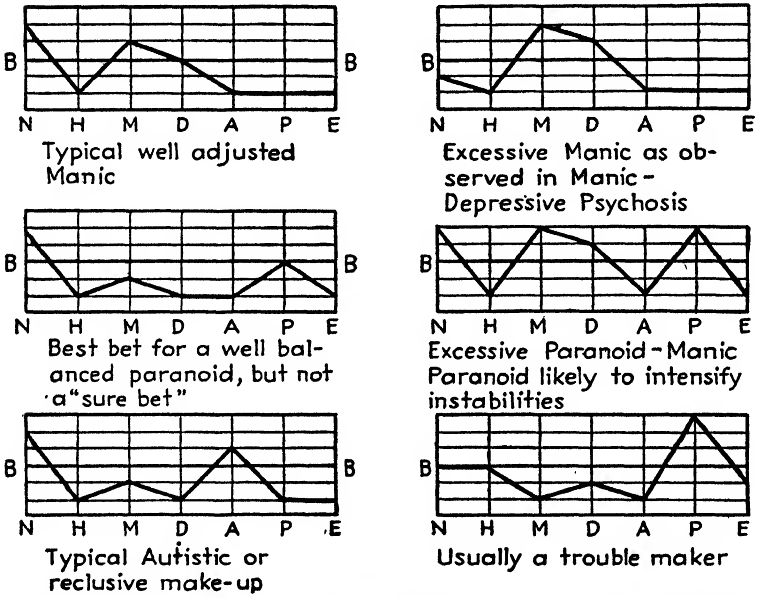

FIG. 22.—Typical personality profiles as shown by the Humm-Wadsworth Temperament Scale. (*Courtesy of the authors.*)

insignificant we find, of course, a very stable personality, but we are also likely to find a more or less colorless one. The value of such a test in pointing out the most desirable lines of work for students or others and the way in which the results can be used in dealing with problems of vocational adjustment are shown in the following discussion by Wadsworth:

In application the temperament scale has been found prognostic of the behavior of employees, and it has become evident that certain components discovered by it are of more value in certain lines of work than in others. In general, people with high "normal" component adjust well on the job; those with low "normal" component frequently are listed among "problem employees." A high degree of "normal" component seems to act as a check upon the disabling features of other components and permit their manifestations within the limits in which they may represent actual assets. Subjects in whom the "normal" alone is accentuated are likely to be dull and uninteresting as individuals, but valuable where conservatism is an asset.

"Normal-hysteroid" people are often personally successful. The "normal" seems to enable them to adjust socially; while the "hysteroid," with its emphasis upon self-interest, seems to keep the subject concentrated upon his own advancement.

"Normal-cycloid" subjects do well where ability to meet the public is an asset or where an ability rapidly to shift the attention is needed, in such jobs as salesmanship, truck driving, general supervising, etc. They are often handicapped, however, by fluctuations of mood and activity, and by emotional thinking and snap judgments attending such thinking.

"Normal-autistic" subjects perform well on routine jobs and on jobs where long periods of isolated application are required. They do well as bookkeepers, watchmen, research workers, etc. They do not meet the public well.

"Normal-paranoid" subjects succeed in work which involves devotion to a cause. They make excellent lawyers, leaders of movements, etc. They relish contention, sometimes even for its own sake. They are often handicapped by the readiness with which they make enemies.

"Normal-epileptoid" subjects do well in pushing through projects. Their devotion is more likely to be to an accomplishment than to a cause. They will work, when let alone, for long periods on a job, finishing it with meticulous zeal. They do well as foremen and superintendents of construction or on any job which requires pushing things through to completion. They also do well in skilled trades requiring unusually careful attention to detail.

They are sometimes likely to waste time in assiduous devotion to a relatively useless hobby.[1]

Personality and the Culture Pattern

The work of Humm and Wadsworth assumes the correctness of Rosanoff's belief that the core determiners of an individual's temperament and hence, to a certain extent, of his personality are hereditary. That such an assumption is not essential to the study of personality in terms of the standard classification of the forms of insanity is well shown by Benedict's use of the same classification to describe the dominant factors in various social groups. Her book, *Patterns of Culture*, is devoted primarily to showing how the cultural pattern into which an individual is born determines his main personality characteristics. She does this by describing various primitive peoples. In the Zuñi Indians she finds a people whose personalities might be described as having the "normal" component as their most outstanding trait. The Zuñi are not a wealthy people in terms of material culture, yet they exhibit little of the economic struggle characteristics of many other societies including our own. The life of the Zuñi people seems to flow along channels that may be characterized as calm, realistic, and free from excessive emotionalism. Warfare is practically unknown among the Zuñi, and murder and suicide are almost incomprehensible. Even the process of courtship and marriage is characterized by an absence of great emotional upheaval. When a marriage fails, as it does sometimes even among the Zuñi, the process of

[1] Reprinted by permission of the *Personnel Journal.*

divorce is undramatic. The wife, who is the one who demands the divorce, having decided upon this course of action, places her spouse's extra moccasins and ceremonial dance shirt and sash together with his prayer sticks outside the tepee. In the evening when the husband returns he recognizes the fatal signs of shattered domestic bliss, sits down and perhaps weeps a little, picks up his bundle, and quietly trudges back home to his mother.

Infidelity is likely to be dealt with in the same calm and dispassionate manner. Bunzel relates one instance in which a Zuñi man had been carrying on an extramarital affair so openly that it became known to all the pueblo. The man's wife took no action whatsoever until she had been earnestly urged to do so by a white man who was a self-appointed guardian of the local morals. In order to put her huband in his proper place, his wife, as she herself told it, "stopped washing his clothes. Then he knew that she knew that everybody knew, and he stopped going with that girl." Benedict comments that this treatment was effective even though no word was passed and there were no emotional outbursts or even any open recognition of the crisis.

Another instance of the Zuñi mildness of temperament is related by Benedict in connection with a controversy over the ownership of a house which arose betweeen two Zuñi families. The yard of the house in which Dr. Benedict was staying with one of the disputants had become overgrown with flowering weeds. The most violent form of protest that the other "owner" could imagine took the form of his appearance in the

yard where he proceeded carefully to clean the yard of weeds, his purpose being, of course, to notify the village thereby that he considered himself the owner of the house and therefore as having the right to care for it. Inside the house, the other claimant fumed a little at this insult, but no words were spoken, and the interloper finally picked up the weeds he had cut, looked around proudly at "his" neat yard, and then went home. "No words were ever spoken between them. For Zuñi it was an insult of sorts, and by his morning's work on the yard the rival claimant sufficiently expressed his protest. He pressed the matter no further."[1] Benedict discounts the idea that the stability exhibited by these people is in any way the result of a hereditary disposition. In fact she is at great pains to show how other American Indians have personalities diametrically opposed to the Zuñi's. She goes on to illustrate the way in which a different type of cultural upbringing can develop a personality that is emotional and suspicious almost to the point of paranoia merely because the individuals in the group are born into a cultural pattern that instills these traits into them as children. The entire social life of the Dobu Islanders is built on a foundation of mutual fear and distrust. It is so much taken for granted that no one would ever perform a social act other than as the result of compulsion that even their romances are forced. One might say that among the Dobu Islanders all marriages are "shotgun marriages." The technique worked out is as follows: as with many South Sea Island people, premarital sexual

[1] BENEDICT, RUTH, *Patterns of Culture*, p. 107, Houghton Mifflin Company, Boston.

relations are not at all uncommon. These relations commonly take place in the hut of the girl's family so that the family could hardly be unaware of what is going on. Nevertheless, since, in terms of American slang, they view this as perhaps their daughter's only chance "to get her man," they overlook the proceedings. Should the young couple finally decide to marry, they do not announce their intentions formally but rather create the impression that they have been "caught" and are hence forced into marriage. Once this course of action has been decided upon, the young man conveniently oversleeps. If he fails to leave the parental hut before sunrise, the girl's mother pretends for the first time to see him and then rushes out to call in all the natives. When he does appear a short time later, he is confronted by the scowling looks of the entire village which has assembled around the door of the hut. Having thus been caught in the act, he makes no attempt to escape but, shamefaced, returns to the hut, where he spends the morning, thus consummating the marriage.

The point of the story is, of course, that these people have the notion of trickery so deeply ingrained in their personalities that they cannot conceive of entering into a social obligation in any other way than through compulsion and trickery. After marriage, strife, suspicion, and all forms of social friction continue to dominate the domestic scenes as it does the relationships between tribes. Benedict uses these peoples to illustrate the point that their personality differences result from their training and not from any basic hereditary differences in their personalities.

The Psychoanalysts

Freud. Despite some later changes in technical definitions the main emphasis in psychoanalysis remains that of unconscious and repressed urges trying to find expression. Also in spite of various redefinitions, the sex urge still remains as the dominant motivating force behind the unconscious behavior patterns. Some of the most fascinating parts of Freudian psychology, at least as far as their literary aspects are concerned, consist of descriptions of the efforts of repressed sexual desires to disguise themselves in various symbolic forms so as to slip into the conscious life past the psychic censor who is always on guard ready to spot them and push them back into the unconscious.

Somewhat more technically, we may say that, according to Freud, the personality includes three agents: the id, the ego, and the superego. The id consists of the many undisciplined, primitive, tempestuous desires or cravings that characterize our animal or at least undisciplined selves. These unconscious urges or instinctive longings are the hidden source of our motivation. Sex, viewed either narrowly or in a broad biological sense, is primary among these cravings. The ego corresponds pretty much to the old "mask" idea of personality in the sense that it represents the individual's disciplined self. It is, one might say, one's self as one knows society expects one to be. The psychic censor is, of course, in the service of the ego and strives to prevent improper aspects of the id from coming into the foreground. The superego corresponds pretty well with the average man's notion of his own "conscience."

Granted the existence of such a complex basis of our personalities, it is easy to see how conflict may arise. The id is constantly trying to "put one over" on the ego, while the ego, by more subtle means perhaps, tries to elevate, or at least regulate the id. Freud and other psychoanalysts have erected an enormous monument of literature in which the outworkings of this struggle are portrayed. What Freud calls the psychopathological manifestations of everyday life, such as the apparently voluntary foregetting of names, slips of the tongue, mannerisms, unreasonable fears, dislikes, or equally unreasonable affections, all are analyzed and shown to be the happy hunting ground of the id. From the therapeutic side, the analyst's job is to dig out these many conflicts, some of which have long passed their active stage, bring them into the cold light of consciousness, and thus readjust the individual.

Freudian psychology has enjoyed an almost universal popularity, which undoubtedly comes from its emphasis upon sex. The fact that the general public is indefatigably interested in sex, may of course, be taken as the strongest possible argument in favor of the correctness of the Freudian view. Professional psychologists of non-Freudian persuasion are inclined to feel, however, that men and women are interested in sex chiefly because it happens to be that one of our many basic urges which is most universally repressed in our particular society and not because it is intrinsically stronger than any of the others. An objective study of the relative strengths of the various urges has been included in the chapter "The Wishes Men Live By." Beyond this point, professional psychologists are in the main quite willing

to give the psychoanalysts credit for forcing a needed recognition of the importance of motivational factors in the study of personality.

Jung. Jung and Adler are the two most famous of Freud's pupils. Each broke away from the original psychoanalytic school and set up his own brand of psychoanalysis. From the standpoint of theory, Jung's most important contribution is his notion of racial memories. He believes that many of the underlying conflicts and motivations that trouble an individual have their origin in a kind of dim inherited memory of the passions, fears, and struggles of one's primitive ancestors. For Jung, the conflict picture is, to express it in oversimplified fashion, the struggle between these prototypes and the motivations and demands of one's current life. In addition to his own brand of psychoanalysis, Jung is famed for the invention of the concept introversion-extroversion. This pair of opposites in the personality field will be considered elsewhere, since they have come to be one of the most popularly known of current theories about personality. In addition, Jung is also recognized in psychological circles as the inventor of the free-word association test, a device in which controlled verbal reactions and their reaction times are used in the study of personality maladjustments as well as more spectacular work of exposing deception as part of the famed "lie detector."

Adler. Adler's theory of personality constitutes a revolt from that of Freud in that he substitutes for Freud's narrow concept of a sex drive a more generalized urge for superiority which becomes something very close

to the more philosophical concept of the "will to live." Adler believes that all the specific personality traits and indeed all the actions of a given personality are manifestations of his particular way of trying to win out in the struggle for existence. Adler has used the expression one's "style of life" to indicate the way in which one individual's efforts to succeed differentiate him from other persons. In other words, one's style of life constitutes the key to one's personality. Adler's views have gained a rather wide and sympathetic hearing precisely because they are based on this broader, biological foundation. His theories originated from his observations of the efforts of animals who were crippled or had other defects to overcome these handicaps and to succeed in the struggle for existence in spite of them. An early scientific paper entitled "Organ Inferiority and Its Compensation" showed how an inferiority in one organ may lead the animal to overdevelop other organs. In the case of humans, for instance, blindness will result in the subject's paying greater attention to the sensory information brought him by his ears, sense of smell, touch, etc. We may well be reminded at this point that such statements do not mean that one's remaining senses will be any more acute than those of other persons, but merely that one learns to make more careful use of such information as any of us might receive.

An important part of the struggle for existence in the case of any social animal is the necessity for maintaining status among other animals. If other animals fear you or if they look to you as a leader your chances of survival are just that much better. Adler believes that a basic

part of nearly every animal's style of life is an urge for superiority. So important is this urge for superiority that it is often set up as the goal of life rather than as the more generalized desire to live. A successful, well-adjusted animal will, therefore, be one that has attained a certain amount of recognition of its superiority and one whose inferiorities have been made up for or compensated for by the development of exceptional abilities along other lines. The development of suitable compensatory activities offers one of the sanest and most wholesome practical channels for the solution of personal problems and for the development of a superior type of personal life.

In some instances repeated efforts to develop successful compensatory activities may fail. Because of these and other failures the individual may fail to achieve the feeling of superiority which he craves. If such failures continue the individual may come to take a negativistic attitude or an attitude of defeatism in which he acts as though failure were inevitable and must be accepted supinely. This condition underlies Adler's famed concept of the "inferiority complex." When present, this failure to develop a successfully integrated personality may lead to defeatism, introversion, and even the pathological manifestations of schizophrenia. One peculiar expression of the latter is the much misunderstood superiority complex. Contrary to public opinion the superiority complex does not grow out of too much success, but is rather an attempted compensation for an inferiority complex. It is really a form of flight from reality in which the individual builds a daydream world

in which he pretends to have all the superiorities he craves but cannot attain in reality.

Pierre Janet on Nervous Exhaustion

The French psychiatrist, Pierre Janet, has developed an interesting theory regarding the causes of nervous breakdown. He visualizes all the different phases of one's personality as being held together by an integrating force. This force is measurable in terms of the supply of nervous energy possessed by the individual. The fund of nervous energy must be at all times sufficient to resist what he calls the "psychic tension," or the tendency for the different personality phases to break up. When the psychic tension becomes too great, or when the supply of nervous energy is exhausted, as it may be, owing to poor conditions of nourishment, social conditions, or other forms of maladjustment, personality disorders will follow. Janet has used the analogy of "overdrawing one's bank account" with the resulting bankruptcy which follows such a condition if it is not remedied. We all recognize that in a certain sense we have a number of different personalities. Thus we conduct ourselves according to one pattern in certain social situations and according to quite a different pattern in other situations. Our pattern of behavior when we attend church is quite different from that which we use when we attend a party or when we are on the campus or in the classroom. When the psychic energy falls so low as to be incapable of integrating all these many phases of one's personality, a condition of dissociation results. This is the explanation of the interesting phenomenon of split personalities

which has occupied much of the attention of abnormal psychologists. Janet has himself described several cases of split personality as have certain American psychologists. Morton Prince, in his book *The Dissociation of Personality*, has described what is, perhaps, the most famous case. Franz has recently discussed another case of split personality in a veteran of the First World War in his book *Persons One and Three*.

Perhaps the notion of split personality can best be made clear by a brief description of a typical case. This case is one described by Goddard in his book entitled *Two Souls in One Body*. A young lady, attractive in appearance, of normal or superior intelligence, was brought to Professor Goddard for treatment. She was nineteen years of age and is referred to in the study by the name of Norma. This was the true personality as she was finally found to be; but, when she was first seen by Goddard, this nineteen-year-old body was apparently inhabited by an entirely different person. This person called herself Polly and announced herself to be four years of age. She spoke baby talk using such sentences as "can her do it." She was found to score on an intelligence test at a four-year-old level. She could neither read nor write, although the true Norma was fairly well educated and had a personality quite the opposite from the outspoken and willful one of Polly.

Through a period of several weeks Goddard studied this case and noted the interesting fluctuation that would occur, sometimes as often as several times per day, between these two personalities. The changes from one personality to another almost invariably occurred dur-

ing short periods of sleep. Sometimes these would be brought on as a result of the girl's falling over in a faint or stupor. Sometimes sleep would seem to come on naturally. In any case the subject would fall asleep as one personality and waken as the other one. In one case Norma disappeared and was supplanted by Polly for a period of about 6 days, and reappearing she took up her conversation where she had left it 6 days earlier. Cases similar to this are also found in what is called "fugue," in which a person suddenly disappears from the normal surroundings and may later be found living in a different community and often carrying on an entirely different type of life from the one he left. These instances are few and almost always occur at a time when the individual was under some severe strain, such as being confronted by an apparently insoluble adjustment problem.

Goddard explains his case in terms of the theory of Professor Janet. Norma was a girl who, although she had been fairly happy in her early childhood, had experienced a series of grave tragedies and extreme nervous shocks during her later adolescence. Her parents had both died under distressing circumstances. She had had some distressing sexual experiences and in the later years she had been placed in foster homes in which there was little sympathy or understanding of her difficulties and where in some cases she was actually frightened and caused to have unnecessary fears regarding her personal safety. The actual break in her personality came when she had managed to obtain a 2-week vacation in the country. Here she found herself amid the quiet and restful scenes of her own childhood. She also contacted her

little four-year-old sister with whom she played and who undoubtedly reminded her of her own carefree baby days. What one of us has not at some time, when confronted with what seemed to us to be intolerable problems, thought that, if we could only get away from it all and get back to some simple type of life, we would be much more content and happy? Such thoughts undoubtedly presented themselves to Norma, as she contemplated the termination of her vacation and the necessity of going back to the squalor and misery of her life in the city. The result was that the day before she was to leave she fainted for the first time and when she reawakened she was found to have taken on the personality of this imagined child in whose person she could find escape from her suffering.

Through a long period of study, careful medical treatment, rest, and through a change in environment which would take the child away from the previous surroundings, Goddard was gradually able to bring the two personalities together until finally they were both rewelded into one personality. Norma is at present an apparently normal and healthy girl and will probably remain so provided her frail nervous system is not again subjected to the terrific strain through which she has passed. This case illustrates more clearly than could any description the theory upon which Janet's concept of personality is based.

In dealing with problems of multiple personality or with nervous disorders of any kind, the first thing that must be done is to ascertain the source of the excessive psychic tension. The psychologist must decide which

phase of the individual's personality was subjected to such excessive strains as to cause it to break away from the rest.

Numerous methods for investigating the personal history have been used. The method of psychoanalysis about which we have heard so much is such a technique. Janet himself uses a modified form of psychoanalysis, but depends to a large extent upon hypnotism as a means of probing into the concealed phases of one's personality. When a subject suffering from a nervous disorder comes to the psychiatrist, the subject is himself usually unaware of the true source of his problem. This self-deception lies at the basis of the somewhat fantastic idea of the "subconscious mind." By means of hypnotism Professor Janet is able to help the subject overcome his own repressions and thus bring to light the actual causes of his difficulty.

Hypnotism is a much misunderstood phenomenon. Because it has been abused in the vaudeville and elsewhere, many people have come to believe that there is no such thing. Others have accepted the fantastic notion that hypnotism is the product of some powerful and usually evil will working on another person. All such ideas are, of course, fallacious. Hypnotism is a real psychological process. It consists essentially in arriving at a heightened degree of suggestibility through causing the subject to concentrate upon a certain line of thought. Hypnotism is in no sense mysterious, nor does it imply any supernatural powers on the part of the hypnotist. Like any other psychological method in which a considerable influence is exerted upon the patient, the use

of hypnotism should certainly be rigidly restricted to psychologists or other trained persons. A very valuable psychological tool has been rendered almost useless for professional purposes because of the fact that "quacks" and vaudeville artists have been allowed to use hypnotism and to build up our present misconceptions concerning it.

Methods of Treatment. Janet, in agreement with many other psychiatrists, sees three outstanding methods for treating nervous troubles. The first of these is reeducation. Nervous troubles are almost invariably expressions of poor habit systems. These habits may be habits of thinking and habits of acting. In either case, the important thing is to build up new habits to take the place of the old. Janet has used hypnotism with marked success in establishing these new habits. Waking suggestion and other techniques known to psychologists are also valuable.

The second method of treatment is that of social adjustment. In these cases the individual's habits are not particularly at fault, but the social environment in which the individual finds himself is so impossible that a break has occurred. In these cases, the social environment must be modified; if necessary, by bringing about a complete change in the patient's life through moving to a different community, if his present social environment cannot be changed. In the case of Norma, which we have just described, the break resulted fundamentally from the girl's impossible social life. Once her own mental processes had been straightened out, it became absolutely essential to place her in a more satis-

factory environment. Had this not been done, she would certainly have suffered an early relapse into her condition of dissociation.

The third method of treatment is that of rest. Janet, more than any other psychiatrist, has insisted upon the importance of rest in treating nervous disorders. He points out that the neurotic person is a sick person. His nervous energies have been exhausted, and hence the first step in treatment is to cause a person to rest so as to rebuild his physical energies. He often insists upon a subject's remaining in bed for a period of days. Merely going to bed does not, of course, ensure that the patient will rest. It is a commonplace saying that we take our worries to bed with us. Neurotic individuals sometimes have the very great difficulty of lying awake in bed because of the endless chain of worry that runs through their minds.

In connection with this last problem, Dr. Jacobson has made valuable contributions. Through his study of the physiology of relaxation, he has shown how it may be possible to relax muscles consciously and so obtain relief from physical strain which is the almost universal accompaniment of worry. As a matter of fact, when the physical strain can be eliminated, the patient will generally find that the worry has gone too. This does not mean that you can treat fundamental maladjustments by merely causing the patient to relax. It does mean that if an attack has been made upon the cause of the patient's maladjustment, rapid progress can be made toward rebuilding his energies and setting him upon a new line of action.

Gestalt Psychology

The acceptance of the Gestalt view in psychology carries with it certain rather important implications relating to personality theory. In the first place, there is implied the view that personality is a totality that cannot be broken up into parts. Opponents of the Gestalt theory are likely to feel that there is much of the old instinct idea in the Gestalt view of personality. To say that an organism responds to a given social situation in a specific pattern because of its configurational organization or because all its reactions are total and unconditioned reactions is not so different from saying that the organism reacts instinctively. As a matter of fact, Koffka, one of the leaders of the Gestalt movement, insists, according to Heidbreder, that

> Instincts too, are Gestalten. An instinctive action, Koffka insists, is not a chain of reflexes, not a mere succession of part-activities, but a continuous process, a unified whole in which every part-activity is determined not only by its immediate predecessor but also by the total activity and by every phase of the total activity—particularly by the nature of the act that terminates the process. One of the conspicuous characteristics of instinct, its tendency toward an end or goal, gives a particularly good illustration of "closure" in a temporal Gestalt.[1]

The Gestalt view of personality naturally carries with it many important implications for both theoretical and practical work in the field of personality. In the matter of personality measurement, for instance, the whole field of analytic measurement would seem to be ruled out, since the breaking up of personality into parts and

[1] HEIDBREDER, EDNA, *Seven Psychologies*, p. 354, D. Appleton-Century Company, Inc., New York.

measuring of these parts would violate the integrity of the personality configuration. As a matter of fact, this is exactly what has happened in the case of some German psychological work on personality. Military psychologists, as we have seen, in attempting to evaluate the leadership and other personality qualities of German army officers have come to use what they call the "characterological" approach. Characterological analysis lays heavy stress upon possible hereditary factors, attempts to evaluate the presence of proper racial ideology, and the degree to which the proper party-conditioning along the lines of ethics, education, and morale have been attained. This means that, as Ansbacher has pointed out, qualitative methods of procedure must take the place of quantitative ones. Indeed, the whole psychological testing program for German officers is highly subjective when compared with our American ideals of laboratory techniques. Ansbacher[1] says,

> German military psychology in all its branches is dominated by the characterological approach. The most important branch is selection. The method is always the attempt to place the testee in realistic situations where his entire behavior is rated with emphasis on personality. This rules out exact measurement. Objectivity is attempted instead by requiring the agreement of several examiners in the interpretation of a behavior symptom before it is considered as indicative of a trait. Within the delimitation of the *qualitative* method the procedure is psychologically sound and is likely to be an effective selection device.

It must be admitted that the qualitative method seems to have produced excellent results in the case of

[1] "German Military Psychology," *Psychological Bulletin*, June, 1941, p. 385.

the German military machine. Whether or not objective laboratory methods could be as successful must remain problematical, at least until our American or some other military leadership shall have been able to apply objective psychological measures to the solution of its problems of leadership, personnel selection, and treatment of personality disorders.

Psychotherapy

Psychotherapy refers to the treatment of minor nervous disorders. No person is entirely free from one or another form of maladjustment or nervous habit. Most of us go through life without any specific attempt to remedy these matters. When our personality maladjustments become acute, it is the part of wisdom to seek skilled psychological guidance in finding our way back to happiness. In seeking psychological counsel, too much stress cannot be laid upon the importance of avoiding the great number of "quacks" who operate in this field. As we have already seen in our earlier chapters, there are hosts of people who call themselves psychologists who have no training and no basic understanding of the problems with which they are attempting to deal. Contact with these "quacks," whether they be conscious frauds or merely misguided persons, is almost sure to lead to financial loss and frequently to an aggravation of the problem that exists.

One can only urge that in selecting a psychological adviser the same care be exercised as would be used in selecting a medical consultant. One would want to know that one's physician held an M.D. degree and was from

a reputable university. We may repeat that a psychological consultant of merit can be determined by application of any one of several standards. First, he should hold an advanced degree (M.A. or Ph.D.) from a reputable university; this degree should represent work done in the field of psychology. Secondly, the man may be accepted as a well-qualified consultant if he is a member of the American Psychological Association, and lastly if he is a medical doctor (M.D.) who has specialized in nervous problems.

In many cases one's personality problems are not of a degree of severity that requires consultation, although a more frequent contact with psychological advisers would no doubt reduce the number of nervous cases that become grave. Self-understanding through the type of study that has been undertaken in this course will frequently point the way out of one's difficulty.

The core of psychotherapy is reeducation. Maladjustment usually results from the formation of undesirable social habits. Where this is the case, the only answer to the problem is the formation of new social habits. The direction of emphasis in these new social habits can usually be determined through an understanding of one's present personality tendencies. It is for this reason that our present work has stressed the measurement of personality traits so strongly. In industry certain psychologists have achieved marked success in assisting employees in the solution of their personal problems through the administration of psychological tests and through carrying out a program of readjustment of work and psychological advice. The work of Wadsworth,

using the Humm-Wadsworth test, and of Anderson are outstanding examples of this.

A fundamental point in self-analysis is the need for realistic thinking. One needs to realize that one's problems are not mystical demons that are attacking him but specific maladjustments growing out of improper social action. Worry, which is perhaps the greatest bugaboo of modern life, can be shown to be nothing more or less than the habit of performing unending series of useless stereotyped movements. These sometimes unobservable muscular contractions, which are the accompaniments of what is going on when we say that ideas are continually running through our minds, account for much in the way of nervous exhaustion.

Toward the treatment of such problems, one can perhaps do no better than to urge every person so troubled to read the outstanding contributions that have been made in this field by Dr. Jacobson. He has made a detailed and scientific study of the causes of nervousness and has followed this with the presentation in popular language of a thoroughly practical program of treatment through the proper use of relaxation. His little book, *You Must Relax*, should be read and its instructions carefully followed by all persons who are troubled with excessive nervousness, worry, or other minor personality difficulties.

SUGGESTED READINGS

BENEDICT, R.: *Patterns of Culture.*
BOAS *et al.*: *General Anthropology.*
BROWN, J. F.: *Psychology and the Social Order.*
GARRETT, H.: *Great Experiments in Psychology*, rev. ed., Chap. 4.

Gray, J. S.: *Psychology in Use*, Chap. 11.
Heidbreder, E.: *Seven Psychologies.*
Morgan, J. J. B.: *Keeping a Sound Mind*, Chap. 14.
Plant, J.: *Personality and the Culture Pattern.*
Preston, G. H.: *Psychiatry for the Curious.*
Rosanoff, A. J.: *Manual of Psychiatry*, 7th ed.
Shaffer, L. F.: *Psychology of Adjustment.*
Woodworth, R. S.: *Contemporary Schools of Psychology.*

Chapter 6

PERSONAL ADJUSTMENT PROBLEMS

When internal stimuli give rise to urges, the natural response is to engage in activity leading directly to the satisfaction of these urges. Unfortunately, it often happens that such action is impossible. When an urge is aroused under circumstances that prevent its satisfaction, a wide variety of results may ensue. A study of these resulting activities has given us the clue to many problems relating to human personality.

Urges may be blocked through one or more of three situations: (1) Physical obstacles in the environment may prevent the satisfaction of the urge; (2) other insistent but antagonistic urges may be present; (3) ideals, taboos, or socially acquired habits may stand in the way of the satisfaction of the urge.

In the case of lower animals, the blocking is usually of the first type. In the case of human beings, it is almost always of the last two types. Occasionally, of course, we find ourselves inhibited through actual situations in the physical environment. Much more common, however, are conflicts that arise through a clash with conventions or through ambition along lines which conflict with the immediate goal.

It is interesting to observe that the method of choice described above in measuring the strength of urges in

animals utilizes the situation of "other insistent but antagonistic urges." The method of obstruction, of course, utilizes the situation of physical obstacles in the environment. Since the inhibition of ideals and taboos is characteristic only of human beings, this method has not been utilized in objective studies of urges in animals.

It has already been pointed out that when an animal is blocked in its progress toward a goal, the pent-up energy will take the form of random trial-and-error activities leading to an indirect or roundabout achievement of the goal. If a given method of attack proves successful in one case, it is more than likely to be attempted in the case of later blockings. If a method of attack proves successful on a number of occasions, the animal may come to be characterized by this particular method of attack on a problem. Examples of this are the conduct of the opossum that plays dead and the killdeer bird and other birds that simulate personal injury in order to lure the hunter away from their nests. Human beings also come to adopt characteristic ways of getting around their inhibitions. The type of adjustment that a given individual has settled upon as his usual method frequently offers a key to his whole personality. Indeed, whole schools of psychological thought have been built up around the interpretation of a given type of adjustment.

In reading the following description of some of the more characteristic adjustment types, the student should bear in mind that we are discussing not abstract principles but kinds of conduct which he himself actually uses in his daily life. If the reader will seek

examples from his own life of the adjustment methods described, he may thereby gain considerable insight into his own personality mechanisms.

Regression

When an individual's present life problems become so baffling that he feels himself quite unable to continue to meet them, he may seek adjustment through ignoring his present life and conducting himself as though his world were the world enjoyed by him in his youth. The mechanism of regression resembles that of dissociation of the personality. The individual may in some cases revert to his own childhood life or in other cases to a happy childhood existence fabricated out of his imagination.

Most of us when tired or discouraged have observed in ourselves a tendency to force a simplicity into our solutions by a temporary use of this regressive mechanism. The poet had this in mind when he cried out in despair, "Backward, turn backward, O Time, in your flight, Make me a child again just for tonight!"

Some types of dissociated personalities give rise to what we call a multiple personality. In this situation, the individual lives in only certain parts of his real world at a time. The part in which he lives, *i.e.*, whose existence he recognizes, is usually the part that is relatively simple and free from inhibitions.

Prince, Goddard, Franz, and Janet have described interesting cases of persons who had undergone such dissociation of their personalities. Janet has developed an entire school of thought based upon his conception of

dissociation as resulting when the individual's nerve energy supply proves to be inadequate to the needs of his social situations. Much of our understanding of the problems of normal personality has come from a study of these cases. We shall, therefore, return to a more detailed study of the regression mechanism in our chapter on personality and emotion.

Compensation

In compensation, we make up for our inability to satisfy an urge for success in one field by achieving outstanding success along some other line.

Adler has observed that an inferiority on the part of one organ of the body tends to bring with it an overdevelopment of some other organ. Thus, an individual who has lost his arms may actually learn to write with his toes. The writer has had as a pupil a young man who won a world's championship in rope climbing. Another man of his acquaintance achieved outstanding success on the parallel bars. Both these men were crippled in the use of their legs. Both had sought and achieved success in physical activities through the overdevelopment of their arms and upper torso. A sane program of compensatory adjustment is, perhaps, one of the most useful types of adjustment possible.

One form of compensatory activity that has been much discussed and praised is that of *sublimation*. Originally, the concept referred to the situation in which one would divert the energies associated with unrequited love or mere sex frustration into presumably nobler channels such as creative artistic work or the carrying

out of some great social welfare project. Undoubtedly, sublimation is an important and socially acceptable device. The only trouble is that, if the urge that is being sublimated is strong, one may run into complications. It is all very well to enter a nunnery or to become a missionary in China when disappointed in love, but, unfortunately, one will probably find that one's urges continue to exist. The somewhat optimistic notion that sublimation can completely do away with undesired urges reminds one of the story of the Scotchman who tried to teach his horse to sublimate its craving for hay. The reader will remember that all went well until the day when the Scotchman had completed the group of lessons in doing without hay. Unfortunately, on the same day the horse had learned to do without hay, it also died!

Introversion-extroversion

The human being, like other animals, first reacts to blockings through a series of trial-and-error efforts. This series of direct attacks will in many cases lead to the desired goal. Persons who have had success in achieving goals in this way come to adopt the method of direct dealing as their characteristic mode of attack. They are called extroverts and are characterized by their interest in the outside world. They are little given to inward ruminations or detailed self-analysis. The extrovert tends to like people and to like social life because he has found that through his social contacts he can achieve the things he wants. The extrovert personality type is likely to succeed in salesmanship and political life and

in the types of business relationships in which the "hail-fellow-well-met" is at an advantage.

Persons who have not enjoyed particular success in gaining their ends through such an open attack upon their environment may be thrown back upon themselves and come to seek adjustment through daydreaming and other forms of imaginary situations. The introvert is typically the daydreamer. He enjoys the achievement of many of his goals vicariously. In a world so organized as to render impossible the achievement of many of our objectives, vicarious enjoyment may often be a most useful thing.

The characteristic use of this type of adjustment usually takes one of three lines. The individual may develop *ideas of grandeur.* Since he cannot achieve great things in real life, he satisfies himself by achieving them in his imagination. What person has not painted for himself pictures of what he would do if he had a million dollars? What person has not imagined himself a successful businessman, a hero on the athletic field, or a great scientist astounding the world with his revelations? What woman has not imagined herself a beautiful society belle, an outstanding artist, or an eminent clubwoman?

Ideas of persecution constitute a second line of introverted action. This response is typified by the little boy who says when disappointed, "I hope I die, then I guess you will be sorry." Probably ideas of persecution always refer back to an imagined self-glorification to result from the persecution. In adult life, this trend has some times been called the "martyr" complex. Those who derive

satisfaction from describing in detail the sufferings they have endured in their latest operations are probably using this type of mechanism.

Identification is perhaps the most widespread and typical variety of introvertive adjustment. In identification, we identify ourselves with some person who has achieved a goal desired by ourselves. At least two great institutions in civilized life are based largely upon this particular mechanism. They are (1) the novel and (2) the drama, especially as exhibited in the modern movie. In the reading of novels, we are likely to identify ourselves with either the hero or the heroine and to enjoy vicariously the struggles experienced by them. In the movies, the imaginative process is rendered still easier through the presence of the actual visual stimulation. The importance of happy endings for both novels and movies is at once clear when we realize that the end of this introverted function is the achievement of a goal. The intrigues and obstacles to be overcome can be endured even in imagination only when we are assured that in the end we shall get what we want.

Introversion as a method of adjustment is of immense value in easing the bitterness of failure otherwise inevitable in our complicated social system. It becomes undesirable, perhaps, only when indulged in to such an extent that it takes the place of efforts to achieve goals that we can and should achieve in reality.

C. J. Jung is the author of the theory of personality based upon the concept of introversion-extroversion. Following his work many interesting tests for measuring this trait have been developed. One of the best of these

is the test developed by Neymann and Kohlstedt. The great advantage of this test is that it has been validated upon psychopathic cases in which introversion or extroversion is known to be present in an abnormally large degree. Psychiatrists have long known that the form of mental disorder called "manic-depressive psychosis" has, as one of its characteristics, a strong extrovert tendency. In the manic state the individuals are overactive, move rapidly from one task or interest to another, talk volubly, and are always "about to" carry out some important social or business enterprise. In their depressed conditions they are, perhaps, less active and more pessimistic but, nevertheless, their interests turn outward. On the other hand, the type of mental disorder called "dementia praecox" is characterized by introversion. In the case of this disorder the introversion is thought to result from a slowing down of the individual's mental processes. In other words he is introverted because he has not the necessary energy to carry on normal social activities. The Neymann-Kohlstedt test was standardized by presenting a list of one hundred questions to a group of these persons. From the list fifty questions were finally selected, these being the questions answered most commonly in one way by the manic depressives and in the opposite way by the dementia-praecox patients.

Jung believed that introversion and extroversion constitute two separate types into which most persons fall. The present consensus of opinion, however, is that introversion and extroversion, like most traits, constitute parts of a mono extroversion, modal curve. Thus we find

introversion-extroversion to be the extremes of a general tendency which has been called "ambiversion." In other words, most people respond at times extrovertively and at times introvertively, depending upon the situation.

In giving the Neymann-Kohlstedt test to large numbers of students, it has invariably been found that somewhere in the neighborhood of 50 per cent of the group will be found to be ambiverts. Approximately 20 per cent of the group fall in the introvert side and 30 per cent fall in the extrovert side. This latter fact brings out the point that younger people are more likely to be extrovert than are older people. In our discussion of the theory of Rosanoff we saw that introversion-extroversion may also be viewed as parts of other underlying components of personality based upon a much more thoroughgoing analysis of humans in terms of exaggerated human conduct in abnormal cases. Here also we saw the clinical method used by Neymann and Kohlstedt carried to its highest expression in a more complete analysis of personality components.

Rationalization

In rationalization we offer a *good* reason for doing something—but not the *real* reason! Gates has appropriately pointed out that irrationalization would be a better term for this type of adjustment since it involves a "more or less complete blindness to all evidence except that which favors our side of the case"! Rationalizations are attempts to explain away either socially or to ourselves shortcomings in our conduct which cannot reasonably be justified. The use of one or another of the forms

of rationalization probably constitutes the most common of all the adjustment mechanisms. They constitute an almost daily part of each of our lives.

Projection is avoidance of the admission of our own failures by placing the blame on some other person or object. The adage, "The poor workman blames his tools," covers this point. If we miss an easy stroke with the tennis racket, we look questioningly at it to see if it may have a hole through it. Divine agencies have always come in for a heavy role as recipients of blame for our weaknesses—"Blaming it on the Lord" has long been a favorite method. Since the time when Adam said "The woman tempted me and I did eat," men and women have been shifting the blame for their conduct onto each other.

The "sour grapes" mechanism, named after the famous fable, is also put to much use. If we cannot have something we really want, we explain it away by showing that we really do not want it. People forced to live in modest downtown apartments hasten to explain that they dislike large showy houses and that the servant problem in them is unbearable. The whole fallacious belief in a "law of compensation in nature" is related to this mechanism. It is commonly stated that great athletes and beautiful girls are usually "dumb," while on the other hand, highly intelligent people are inclined to be physical weaklings with queer ideas and neurotic tendencies. Such ideas, which are known to be false, illustrate the persistence with which we cling to the particular notions which "favor our side of the case."

The "sweet-lemon" mechanism enables us to sing "God's in his heaven, all's right with the world" in the face of the blackest despair and the most complete evidence, such as in wartimes, that all is *not* right with the world. This tendency to claim that bitter medicine is really sweet gives rise to the Pollyanna attitude. The Pollyanna attitude is undesirable as a basic technique for the same reason that all rationalizations are bad—they allow us to drift along without doing anything toward remedying the *real* problems.

Prejudice and illogical and unscientific ways of thinking all relate to the widespread tendency to rationalize. "Convince a man against his will and he'll remain of the same opinion still" characterizes too many of us, not only in our political, religious, and economic opinions but in the little matters of daily conduct. Man's greatest attribute is his ability to change—yet rationalization often seems to be enlisted in the service of helping us to avoid changing—even when change would be to our own best interests.

Defense Mechanisms. This technique enables us to avoid reality by building up more or less elaborate escape devices in form of chronic headaches, indigestion, fainting spells, or any number of other *imagined* ills which if real would prevent us from performing certain duties. Parents are frequently amazed at the miraculous cure of sick headaches which a telephone invitation to a dance brings about in their daughter who was too ill to help with the dishes or to do her homework.

Defense mechanisms are often carried to the point where they represent truly neurotic conditions. A most striking example of this is "shell shock." Shell shock has

no direct physical relation to the exploding of shells. It is a form of hysteria in which any of a number of nervous or physical abnormalities may be simulated. Certainly one can scarcely "blame" the soldier for seeking this escape from the horror of modern war—and the soldier himself would be the last one to realize that he was trying to escape!

Analyzing Adjustment Problems

The too extensive use of any of these adjustment methods indicates an undesirable personality situation. It indicates the existence of maladjustments toward the real solution of which little *real* progress is being made. If we desire to work toward more satisfactory methods of adjustment, it will be well if we can begin by getting some notion as to the nature of our major maladjustments and in which fields they tend to center. Helpful analyses can be made with the aid of such devices as the Bell Adjustment Inventory. By answering the questions in this or similar studies, it will be possible to gain a much clearer notion as to where one stands on this important matter.

Having ascertained one's status relative to one's home, health, and social and emotional adjustments through filling out the blanks provided, it remains for the student to undertake a realistic program of improvement through the formation of new habits.

Personal Problems Related to Sex

Sex and Hunger Rule the World. Most of the little sex training that is given to our young people seems to be founded upon a complete ignorance or misinterpretation of the most elementary facts about the psychological nature of sex. Most people probably know that hunger does not originate from the sight of food but that its true origin lies in an internal feeling associated with an empty stomach. As is shown elsewhere, psychologists have performed experiments that prove that the feeling of hunger is associated with the contractions of an empty stomach just as thirst grows out of a parched condition of the lining of the throat. The sight of food operates as a learned or conditioned stimulus to start eating activities to fill the stomach and stop the hunger pangs.

The mechanism by which the sex urge operates is almost identical with that of the hunger urge. This bit of knowledge was early stressed by F. H. Allport in his famous *Social Psychology*, which was first published in 1924 and which marked the introduction of objective methods and interpretations into the field of social psychology. In a splendid chapter dealing with the development of fundamental activities Allport showed, first, that the original source of the sex urge lies within the reproductive system of the individual and that, as in the case of hunger, the external stimulus merely releases activities that may lead to the satisfaction of this internal urge; and secondly, that the particular pattern of action by which the sex urge may be satisfied is in no sense inherited or instinctive. These facts are of such basic importance for an intelligent solution of the sex

problems that beset modern man that they deserve a fairly detailed analysis.

The immediate source of the sex urge in the male lies in the pressure which the reproductive fluid exerts upon the seminal vesicles. Fundamentally this internal pressure is not different from the pressure exerted by urine upon the bladder. The basic nature of the urge in the male is, therefore, nothing more or less than a need for the release of this pressure through a discharge of the accumulated liquids, just as the pressure in the bladder gives rise to the urge to void urine. In addition to this direct motivating factor there is, of course, in both the male and the female the influence of the endocrine products or sex hormones. This type of stimulation seems to be the predominant one in the case of the female, which accounts perhaps for the lesser immediacy of the sex urge in the female. In the female the congestion and heightened sensitivity of the sex organs just preceding and during the menstrual period probably acts much as does the seminal fluid pressure in the male. In any event we know that the sex urge is at its peak in the female just before the menstrual period and, indeed that in the case of lower animals the female will accept the male at no other time. The fact that the human and perhaps a few other animals do not restrict their sex relations to this period affords an excellent illustration of the importance of acquired motivations as discussed earlier under the heading of "The Functional Autonomy of Motives."

The sex urge in the human affords one of the finest illustrations available of the fact that the presence of a basic urge or tissue need does not carry with it an instinctive or unlearned knowledge of the most appro-

priate method of satisfying that urge. As Allport has said,[1] "The sexual drive—that is the internal stimulating secretions—and the random activities to which they lead are truly innate and hereditarily determined. The act of pairing between male and female, however, seems to be the result not of instinct but of learning."

Sex Training Imperative. The foregoing analysis shows that the sex urge is a blind outcropping of a drive and that the specific channels of expression are not inborn. The structure of the animal will lead it in the majority of cases to discover the mode of expression that is most logical and therefore will constitute its normal manifestation. If this normal expression is blocked for any reason, however, the urge may very well come to acquire other forms of satisfaction. Two of the more common of these substitute satisfactions will be analyzed by way of illustrating the point and also because a sympathetic understanding of persons who have adopted these abnormalities is needed.

Masturbation is probably the most common of these substitute expressions of the sex urge. Contrary to popular opinion masturbation is practically a universal phenomenon among human beings and even appears commonly among certain lower animals. Many forms of self-stimulation are come upon quite accidentally by young persons of both sexes. Accidental pleasurable stimulation of the sex organs may occur through pressure of clothing, climbing trees, or in a variety of other ways. It is to be noted that masturbation as used here includes not only artificial stimulation of an orgasm but

[1] ALLPORT, F. H., *Social Psychology*, p. 71.

any form of stimulation of the erogenous, or sensitive, zones. From the standpoint of mental hygiene it is important that the commonness of this phenomenon be understood and that the idea that it is accompanied by some horrible and deep-set consequences should be definitely dispelled. Writers are pretty well agreed that the major harm that comes from the act results not from the act itself but from the fear complexes that have been built up around it. Parents and other well-meaning people have tried to prevent this act by telling boys (since it has been wrongly assumed that masturbation is practiced only by boys), that the act is bound to lead to stunted growth, feeblemindedness, or insanity. One writer has summarized the whole discussion on this point by stating that masturbation is no different in its effect from an equal amount of normal sex activity. There is, of course, a danger here that runs through all forms of abnormal sex expression, *viz.*, that the setting up of substitute habits of gratification may well stand in the way of the later development of correct sex habits, thus giving rise to a conflict that will be harmful.

Homosexuality is a second widespread form of substitute sex activity. Here the common notion is that homosexuality is an inherited abnormality and that the person who inherits this condition must consider himself a slave to it. Modern psychologists are definitely agreed that this idea is false. It is true that inherited physical traits and tendencies toward glandular disfunctions may predispose toward homosexuality in some cases. The usual opinion seems to be that not more than 10 per cent of homosexuality is thus determined. The other 90 per

cent of the cases originate through bad environment, lack of correct sex education, or the inability to attain normal sex expression. The correctness of these figures and the importance of the last-named cause is amply demonstrated by the fact that homosexuality is particularly rampant in institutions where the sexes are segregated, such as penitentiaries for men and for women, army and navy organizations, and boys' and girls' schools. Fortunately, most of these tendencies will be superseded in the normal course of growth or with the appearance of an opportunity for normal sex expression. As with masturbation, the greatest danger lies in the fact that persons who come accidentally to a mild expression of homosexuality are led to feel that they are "condemned" and that they can never escape to a normal sex life. Almost every psychologist has in his private files cases of young persons who have come to him, sometimes even contemplating suicide, because they believed normal sex life to be impossible for them. In the vast majority of these cases a presentation of the facts of the case clears up the fears and points the way to a gradual solution of their difficulties.

Other Sexual Deviations

In addition to these two most common forms of sexual deviation, there are many other forms of sexual expression that deviate more or less sharply from the normal course. We shall see that certain of these may be classified as perversions only when they come to dominate the sexual picture. Some of them, in a mild form, may be considered to be perfectly normal aspects of sex

when they appear as a part of the total pattern of heterosexual relations. The list that follows should in no case be thought of as inclusive but merely as describing a few of the types that the student may be most likely to meet in general discussions or reading.

Exhibitionism and Voyeurism. These two substitutes for normal sex expression are not at all rare and indeed, according to some psychologists, need not be entirely sexual in nature. For instance, a voyeur, or "peeping tom," may be motivated by a morbid curiosity which could scarcely be called sexual unless one followed a strictly Freudian interpretation. The family maid who peeps through a keyhole to spy on her employer may even do so for very practical economic reasons or in an attempt to find out what her own status is with her employer. In the same way, exhibitionism may relate to a generalized desire for social recognition and approval. The coed who preens herself in the latest fashion and then parades on the campus may be much more concerned with matters of being elected to a sorority or to the attainment of other forms of campus recognition than she is with purely sexual matters. It has been said that probably every woman has a bit of the exhibitionist in her make-up and that every man is a bit of a voyeur.

Sadism and Masochism. These terms refer respectively to the deriving of sexual pleasure from the inflicting of pain (sadism) and from having pain inflicted upon oneself (masochism). Here again, it is perhaps possible to say that there is a bit of masochism in most women and a bit of sadism in most men. In such observations it should be borne in mind that we mean only that in our

culture this has come to be accepted as a normal part of the pattern of sex relations. Its origin in the present instance lies in the fact that in our culture the male is the sexual aggressor whereas the female plays the submissive role. These forms of perversion also take expressions that are only indirectly sexual. Many forms of bullying probably have a sadistic element, whereas persons who seem to derive an actual pleasure out of various forms of martyrdom or who take too obvious a satisfaction in their illnesses are probably exhibiting an element of masochism in their natures. According to Freudian interpretation we would also see sadism in the person who is unnecessarily cruel to animals and perhaps a well-disguised and inhibited sadism in persons who have a too great concern about cruelty to animals. In other words, many persons who take a self-righteous interest in societies to prevent cruelty to animals may sometimes thereby satisfy their own morbid interests in that very thing. Masochism may possibly be related to our interest in the "underdog," through our desire to suffer with him, although it is possible to interpret this phenomenon in just the other way, as we have seen. This bit of complexity reminds us again that the many and devious expressions of sexuality in the human are set up and modified by the accidental experiences and the social traditions that come to operate in a given case.

Phobias, Compulsions, and Obsessions. These forms of neurosis may frequently though not necessarily be related to sex. Phobias are irrational and frequently uncontrollable fears. Such fears may become attached to almost any stimulus, such as acrophobia, or fear

of high places, and claustrophobia, or fear of closed places. Phobias with more obvious sexual implications include misophobia, or fear of contamination, and gynephobia, or fear of women. In compulsions the subject has an unreasoning impulse to carry out a certain activity. Such a compulsion, together with an obvious explanation of its cause, is to be found in the famous hand-washing scene of Shakespeare's Lady Macbeth. Frequently compulsive acts symbolize or disguise sexual obsessions. An obsession is the same as a compulsion, except that the obsessions remain largely mental, *i.e.*, do not translate themselves into observable actions. Ideas that keep running through one's head, bits of music, and recurrent dreams all represent examples of obsessions.

Perhaps the two most commonly known examples of obsessions leading to compulsive acts are kleptomania, in which the victim feels a compulsion to steal, and pyromania, or a compulsion to set fires. The objects stolen by a kleptomaniac are frequently of little or no intrinsic value and frequently of no possible use to him. Pyromania has been called to the attention of most of us. In pyromania, especially, we see a reaction that would seem to be not necessarily related to sex. Pyromania may conceivably be stumbled upon by young people merely as a method of having some excitement and intrinsically would seem not to require a sexual element any more than would it be necessary to attribute a sexual craving in connection with the delight most of us seem to find in running after fire engines in order to see a fire.

Narcissism and Infantile Sexuality. According to Freud the earliest object of sex attraction is oneself. This may be explained either in terms of some obscure Freudian mechanism or on the basis of the obvious fact that one's own body and one's own sex organs will come to one's attention as a result of accidental exploration with its resultant pleasure. Narcissism (so called after the legend of Narcissus, who fell in love with his own image as reflected in a stream) usually follows infantile sexuality, which may include such things as thumb-sucking and morbid interest in one's own excretory processes. This may be followed by a period of homosexuality, which in turn leads to the ultimate adjustment, *viz.*, that of normal heterosexual interests.

Society is primarily to blame for most sexual abnormalities. It is to blame in the first place for the sense of prudery and false modesty that has been built up around sex functions. The sex urge must certainly be socially regulated, but it does not need to be regulated by a false pretense that it does not exist. Moreover, the puerile attempts at solving the problem through what has been called sex enlightenment is not likely to prove adequate. The mere fact that young people know something about "the birds and the bees" and that babies are not brought by storks is not enough. As F. H. Allport says, what we need is "not merely sex enlightenment, but sex training." If the point of view here presented is correct, that the sex urge in the human is nonspecialized and therefore can take any of a great variety of channels, it behooves us to teach young people the correct and satisfying methods of sexual

expressions and furthermore to make it economically possible for them to attain marriage and a normal sex life. The eminent juvenile court judge and child authority, Ben B. Lindsey, has certainly been on the right track in his insistence upon some sort of positive treatment rather than a continuation of our old "thou shalt not" attack.

Marriage Happiness and Sex Training. There is no doubt that a great amount of marital unhappiness leading to divorce or to disillusionment and personality distortion grows out of a lack of sex training. Probably few of us are so naive nowadays as to imagine that persons can come to the wedding night in ignorance and then through the operation of some mysterious instinct have revealed to them the techniques necessary for attaining complete sexual satisfaction. An observation of lower animals quickly reveals the clumsiness and ineffectualness of their early sex relations. In human beings where sex rightly or wrongly plays a so much greater role, a similar ignorance is proportionately more damaging. Nor must we imagine that our greater intelligence can give us the answer. Sexual relations are carried out under the stress of great emotion—a condition in which a coldly rational approach is not likely to exist or indeed even be desirable. The only answer is a preliminary knowledge of some of the basic facts important for successful sexual expression so that experimentation can follow along the lines indicated. Failure in this is all too likely to lead to disillusionment and a bitterness toward sex in general that may take the form of a bitterness or hatred toward the sex

partner. Incidentally, a feeling that one has failed to live up to expectations in the matter of sex relations is known to be one of the most deadly sources of an inferiority complex. The truth of this is attested to by the great frequency of questionable stories relating to sexual incompetence if not impotence, and on the other hand the tendency on the part of many to brag about their sexual conquests.

Factors in Successful Sexual Relations. The most common source of failure in sex relations grows out of a lack of understanding of the implications of the basic differences in the sex organs of man and woman. In the male, as we have seen, the sex urge is immediately motivated by internal pressures. The immediate biological objective in the male, therefore, is the elimination of this pressure. This is not to say, that sexual satisfaction in the male is limited to this, for it certainly need not be. The secondary pleasures associated with love-making in the form of the manifold preparatory caresses can come to be just as important and pleasureful for the male as for the female once they have been learned. The point is that the male is not likely to stumble onto these secondary forms of sex expression, and indeed when he does acquire them he usually does so through having learned that they are important for the female. Since the female is not motivated toward sex functions by such a specific interoceptive sensation as is the male, it becomes essential that her general muscular tonicity and desire be developed gradually through preliminary caresses and love-making.

Since the average man is all too ignorant or self-centered to be willing to carry out these essential acts of

sex play the woman frequently fails to derive satisfaction from the act. Indeed it may become so unpleasant to her as to result in severe maladjustment involving frigidity as a personal reaction and domestic discord as a social outcome.

A second outgrowth of this difference in the physical structure of the sexes appears in the fact that the male all too frequently reaches the orgasm before the female has had an opportunity to become sufficiently stimulated to do likewise. It has been estimated that as many as two-thirds of the wives in American homes fail to achieve sexual satisfaction because of the inability to experience the orgasm. Much of this is entirely unnecessary since the man can usually by a little self-discipline and a proper emphasis upon the preliminary activities of sex play regulate his own behavior to meet the needs of the sex partner.

It should not be inferred from these remarks that success or failure in sex relations can be determined wholly by an understanding of sex physiology. Certainly a large proportion of frigidity in women is attributable to their own unfortunate attitudes toward sex, growing out of their girlhood teachings. One cannot be taught through 15 to 20 years that sex is something repulsive and dirty and then suddenly reverse these reactions upon entering the marriage relationship. Again, our failure must be attributed to our stupidity in trying to regulate sex through fear. Our popular picturization of the beauty of love should be extended to include the beauty of the sex act. If it were so extended and other forms of unnecessary sex repression were done away

with, there would be much less of vulgarity and unwholesomeness attached to sex, and there would, we may be sure, be a far greater proportion of successful marriages.

SUGGESTED READINGS

ALLPORT, F. H.: *Social Psychology*, Chaps. 3, 14.
BROMLEY and BRITTEN: *Youth and Sex.*
BURGESS and COTTRELL: *Predicting Success or Failure in Marriage.*
GRAY, J. S.: *Psychology in Use*, Chap. 5.
GROVES, E. R.: *Marriage.*
GUTHRIE, E.: *Psychology of Human Conflict.*
MORGAN, J. J. B.: *Keeping a Sound Mind.*
RICHMOND, W. V.: *An Introduction to Sex Education.*
SHAFFER, L. F.: *Psychology of Adjustment.*
TRAVIS and BARUCH: *Personal Problems of Everyday Life*, Chap. 9.
VALENTINE, W. L.: *Experimental Foundations of General Psychology*, Chaps. 11, 14.

Chapter 7

EMOTIONS AND FEELINGS

Emotional responses, especially those of the more violent types, are now recognized as being related to a preparation for vigorous physical activity. Animals and man in a state of nature frequently find themselves in what Cannon has called "emergency situations." In order to come through these situations successfully, it is usually necessary to engage in flight or combat. In either case, a great and unusual expenditure of energy will be required.

The normal functions of the bodily processes are inadequate to meet these extreme demands. For this reason, the widespread series of internal changes which we are about to study become necessary. The importance of deep-seated organic changes in connection with emotional reponses has probably been known since the beginning of recorded history. Popular speech includes many references to the role that certain organs play in emotional responses. Examples of these are the spleen in connection with hate or anger, the heart in connection with either love or courage, and the intestines as the seat of courage.

The peculiar sensations localized in the region of the stomach in connection with fear responses have given this organ a place in popular literature. Most of these

assumed relations between specific organs and various emotional responses do not, of course, agree with scientific fact. The general concept underlying these expressions is, however, correct. Emotional responses *are* related to various deep-seated changes going on inside the organism. Woodworth has defined an emotion as "a stirred-up state of the organism."

The basic facts relating to the nature of emotions were first expressed in the form of a theory by James and Lange. These two men, working independently, brought forth the James-Lange theory of emotion. William James, who had a happy faculty for putting scientific truths into attractive phraseology, characterized his theory as follows: "The older theory of emotion would say that one sees a bear, is afraid, and runs; I say, on the contrary, that one sees a bear, runs, and is afraid afterwards." In putting his theory in this way, James is stressing the fact that the experience called an emotion is the result of sensations accompanying deep-seated changes in the organism.

In diagrammatic form the older theory might be stated:

$$\text{Sensation} \rightarrow \text{emotion} \rightarrow \text{action}$$

The newer theory would be diagramed:

$$\text{Sensation} \rightarrow \text{action} \rightarrow \text{emotion}$$

The James-Lange theory has sometimes been misunderstood through the assumption that the action of which he spoke was exclusively action under the control of the autonomic system. If we glance a moment at his

illustration of the bear, we might notice, however, that the action that gave rise to the emotional quality was the voluntary-system response of running away. Two contemporary psychologists, Cannon and Allport, have clarified this issue. We may summarize their fundamental point of view by saying that the complete emotional experience is the result of kinesthetic sensations accompanying the voluntary activity, together with organic sensations accompanying the internal changes. Various experimenters have shown that the internal changes that go on during strong emotional experiences do not vary greatly from one kind of emotion to another. Thus, the internal changes in fear and anger are very much the same.

The differences in emotional quality between fear and anger are to be accounted for, then, in terms of sensations resulting from the voluntary muscular activity in each case. In the case of fear, one might have a given set of internal changes plus the muscle sensations involved in running. In the case of anger, one would have the same set of internal sensations but a different set of muscle sensations.

Our diagrammatic presentation of the James-Lange theory may be amplified as shown below to demonstrate the twofold aspect of the actions leading to emotional experience:

voluntary action
/ \
Sensation emotion
\ /
involuntary action

A practical illustration of the fundamental truth of the James-Lange theory in its modern form has been experienced by nearly every person in connection with the driving of automobiles. Assume that you are approaching an intersection at a good rate of speed. As you start to cross, another car swings into view from the side street. By a violent physical effort, you are able to avoid the onrushing car, perhaps careen somewhat wildly, but, nevertheless, right yourself and continue on through the next block. At what moment is the true emotion of fear felt? Is it at the intersection as one turns the wheel of the car, or is it a half block later when one attempts to apply the brakes and finds himself trembling so as to make coordinated movement difficult? Most of us will agree that the latter situation more accurately covers the events.

It is true that at the intersection there was the "consciousness," as Cannon would call it, of the emotion. This phase of the emotional response is that part of the emotion relating to the voluntary muscular movements in handling the car. The complete emotional experience does not occur, however, until the slower acting autonomic system changes can get under way; in this case not until one has passed well out of the scene of immediate danger.

Bodily Changes during Emotions. Psychologists and physiologists have devoted much attention to an analysis of the bodily changes accompanying emotional experiences. The internal changes are under the control of the autonomic nervous system. This system is made up of three divisions. The upper part is called the "cranial"

division, the middle part the "sympathetic" division, and the lower part the "sacral" division. The cranial and sacral divisions work together and produce effects strikingly different from those produced by the activity of the sympathetic system. Activity of the sympathetic system produces a widespread series of changes all related to the release of large amounts of energy. Among the changes that contribute to this end are an increase in heart rate, respiration, perspiration, and the activity of the kidneys. Together with these changes comes a cessation of the activity of the stomach and of those glands related directly to the digestion of food.

An illustration of the latter is the cessation of the activity of the salivary glands in such a way that strong emotion is usually accompanied by a dryness in the mouth. Activity of the sympathetic system also causes the emptying of blood sugar into the blood stream. This sugar is an immediately available form of energy. The adrenal gland is also set into operation by the action of the sympathetic system. Adrenalin in the blood fortifies most of the changes we have just listed and, in addition, has special effects of its own. It stimulates all the tissues that are bathed in it and reduces their rate of fatigue, probably through counteracting the effect of the lactic acids that accumulate as waste products. Adrenalin causes a decrease in the coagulation time of the blood. This interesting phenomenon shows how directly the widespread changes are related to the struggle situations. In combat, wounds are likely to occur. If the blood clots readily, the danger of bleeding to death and of the loss of energy through bleeding will be greatly

reduced. The whole picture as presented is one of marshaling the bodily energies for immediately violent physical activity, accompanied by a discontinuance of those processes not essential for immediate survival.

The changes set up through the operation of the craniosacral division are in a sense the opposite of those controlled by the sympathetic division. Craniosacral changes are related to the promotion of the basic organic processes in the body. Breathing becomes normal; digestive processes, including the secretion of digestive juices, continue in a normal way. These changes are spoken of as giving rise to pleasant emotion or to feelings of well-being.

The Lie Detector. It has long been known that certain bodily changes are often related to a sense of guilt and to lying. Thus, there is the old Chinese custom of forcing each of a group of suspects to chew a mouthful of rice. At the end of a specified period note is taken as to whether the rice remains dry in the mouth of any of the suspects. If it does, this man is presumed to be guilty. This test is made possible by the fact that the salivary glands are made inactive by the sympathetic system, which also stops the stomach and other digestive processes. In a similar way note may be taken of any clamminess in the hands of suspects. This presence of undue perspiration in the palm of the hand may indicate emotional excitement and, indeed, is the basis of the operation of the modern psychogalvanometer in which a faint electrical current is passed through the palm of the hand. If the subject becomes emotional upon questioning, the perspiration increases and the electrical

resistance of the skin is reduced so that a stronger current flows and is recorded on the apparatus. As a matter of fact the psychogalvanometer might well have become one of the most important devices used in lie detection were it not for the difficulty in preventing the electrodes from becoming polarized.

Blood pressure and breathing changes have in actual practice been the most successful indications of emotion in a suspect. Marston[1] places his primary reliance upon the sphygmomanometer, which is the ordinary blood-pressure-measuring apparatus used by every physician. Keeler, who has done extensive work in lie detection in police courts as well as in private industry, also uses blood-pressure readings supplemented by records of changes in breathing as measured by the pneumograph. His apparatus, called the *Polygraph* (pictured in Fig. 23), has been developed especially for this work. Figure 24 shows a typical record made by means of a polygraph and shows how both the heartbeat and blood pressure change in conjunction with deception.

In addition to using the measures of emotional changes to detect actual suspects in criminal cases, several experimenters, including Keeler, Marston, and Larsen, have used the test for a routine examination of employees in banks or other business enterprises. As a result of one such study it was shown that from 15 to 33 per cent of all bank employees were found to be guilty of at least petty stealing—and this in a situation in which no one was particularly suspected! In one

[1] MARSTON, WILLIAM M., *The Lie Detector Test*, p. 99, Richard R. Smith, New York.

remarkable case, the lie detector trapped a man who had not yet stolen but was merely planning to make a theft. Investigation of this case showed that complete plans had been laid to rob a wealthy customer of some $100,000. Supplementing these economic uses of emotion-testing work, a great deal of use has been found for them in clinical psychology in uncovering emotional complexes. Men and women often come to the psychologist with personal problems, the root of which lies in a love relationship that they are unwilling to admit. Naturally the psychologist is likely to be baffled in his attempts to solve the problem until the true motives appear. Marston has been particularly successful in using this test in the uncovering of emotions of such love tangles as well as uncovering several instances in which one or another party was professing love for what proved to be a very materialistic motive. In one striking instance Marston was dealing with a girl who had a fixation upon a man who in turn appeared to be very honest and sincere in his feelings toward her. While blood-pressure readings were being made, the man was asked, "Do you love Miss *X*?" to which he answered with apparent sincerity, "God! I'll say I do!" This exclamation was followed by the question, "Are you making any money out of the confidence racket?" "No sir." "Are you married?" "No indeed." As the reader may have guessed, the absence of blood-pressure changes in answering the first question together with violent changes in answering the last two gave the lie to the man's verbal responses, showing that he really did not love the girl and so showed no emotion on speaking about her. He showed

Fig. 23.—Mr. Keeler using his Polygraph lie detector.

(Facing page 192.)

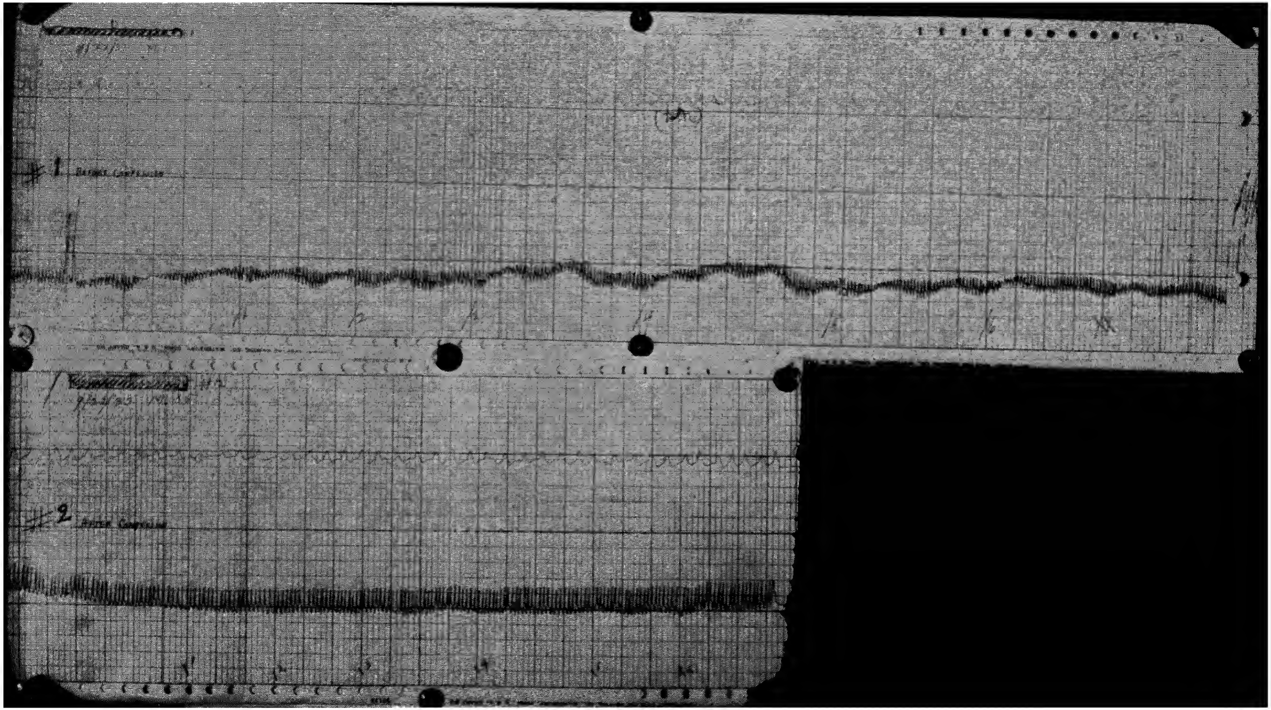

FIG. 24.—Keeler Polygraph record of subject before and after confession.

real fear reactions, however, when questioned about his real occupation and the fact that he was already married. This interpretation was later substantiated by his confession.

A technique for detecting guilt and lies which was used before the invention of the lie detector is that of the word-association tests. In giving verbal responses to stimulus words, it has been found that the presence of emotional changes will result in abnormal reaction times as well as abnormal word responses. Jung and others have used this technique extensively in uncovering not only crimes but various forms of emotional complexes. In this latter use, the technique becomes of great value in connection with the treatment of nervous disorders.

The Genetic Study of Emotions

From a purely practical standpoint, interest in emotions tends to center around the ways in which they have been socially conditioned. The internal changes are, as we have seen, rather similar for most emotional states. To understand their social significance, it becomes necessary to study the ways in which the expression of emotional responses develops.

Professor Watson has concluded that the original emotional responses are but three in number; fear, anger, and love. These simple responses are originally called forth by a limited number of natural stimuli. The fear response can be brought out by only three things: loud noises, pain, and the sudden loss of support. The rage response is brought out by a restriction of the child's movements. The love response, which, of course,

in the child is a very generalized response, probably almost synonymous with the general name "pleasantness" in ordinary speech, can be aroused by gentle stroking of the skin, tickling, or petting.

On the basis of these native emotional responses we find the emotional life of the adult developed. The process by which the emotional life grows is that of conditioning. The conditioning of emotional responses is not fundamentally different from the conditioning of any other of the native reflexes in the child. Just as Pavlov's dog came to salivate upon the ringing of a bell, so babies, under Watson's study, came to exhibit the fear response when presented with a baby bunny. The baby bunny originally called forth only pleasant responses, but by presenting it at the same time that a loud sound (natural stimulus for fear) was presented, the two responses came to be associated. Mrs. Jones, working with Watson, has made a detailed analysis of the methods by which emotional training of the proper type can be effected and by which improper emotional conditioning can be overcome. A statement of these techniques may be found in Watson's book, *The Psychological Care of the Infant and Child;* it is also summarized in Garrett's *Great Experiments in Psychology.*

Since it is the voluntary or outward expressions of emotions that differentiate them into their finer groupings, it follows that we tend to judge emotions in terms of what we can see going on during emotional behavior. Because we do have some limited success in judging emotional experience from outward expression, we all tend to use such outward expressions intentionally to

communicate our own emotional feelings. The face, the hands, and the general bodily postures are the most important factors in giving expression to emotions. A large part of our social communication is related to the purposive use of gestures and facial expressions in portraying emotions.

Psychological studies have definitely shown that the accuracy with which emotions can be judged from outward appearances is not very great. Nevertheless, as Gates has shown, the ability to judge correctly emotions from facial expressions increases with age. This means that the ability to make correct judgments is a result of social training. This will be seen to be an obvious truth when we recall that the outward expression of emotions is also a matter of social training. Both these facts disprove definitely the old idea that people are "born" good judges of other people's emotions, thoughts, and characters. As a matter of fact, many psychologists agree with Dashiell[1] who holds not only that the internal changes for the various emotions are constant, but that the external expressions themselves, on which the names of emotions, such as fear, anger, hate, etc., are based, are only "socially determined constructs" that have been acquired through traditional teaching but do not inhere in the basic responses as such. The author is inclined to accept this view, although some limitations must be placed upon it in view of such studies as those of Allport and Guilford relating to possible structurally determined patterns of response of facial expression. Although it is true that the patterns of facial expressions

[1] "Are There Any Native Emotions?" *Psychological Review*, Vol. 35, p. 319.

relating to various emotions are pretty much a matter of social training, there may be certain ways in which the face is most likely to operate in response to various emotion-producing stimuli. The underlying principle here is our concept of the logic of structure. Guilford has done important work in a critical study of the facial expressions of emotions. He verifies the rather familiar principle that the lower part of the face is more expressive than is the upper and goes on to comment on the role played by each part of the face.

The forehead and brow may operate in either of two ways—the brow may be arched so as to form horizontal wrinkles, as in conjunction with surprise and amazement, or it may be contracted to produce vertical wrinkles associated with unpleasantness or strain. The eyes may be highly trained, with the wide-open eye, indicating interest or fear, and the narrowed eye, traditionally related to suspicion, being important. The nose seems to be relatively unimportant in expressing emotions, whereas the mouth, because of its great versatility of movement, relates to many types of response.

Guilford advances the ingenious explanation that the basic types of emotional reaction as shown by the mouth tie in with the four fundamental taste qualities of sweet, sour, salt, and bitter. Thus in sweet we find a pursing of the lips as if the substance were held in the lips to be tasted with the tip of the tongue which is the part richest in taste buds for sweet. Reactions to bitter substances, which probably come to be associated with feelings of disgust, include a curling down of the lip and a protrusion of the tongue so as to expel substances from

the back of the tongue where the bitter receptors are numerous. The peculiar pulling down of the face in sour relates to the effort to let substances move away from the sides of the tongue where the sour receptors are numerous. Since the salt receptors are distributed pretty uniformly over the tongue, we find no charac-

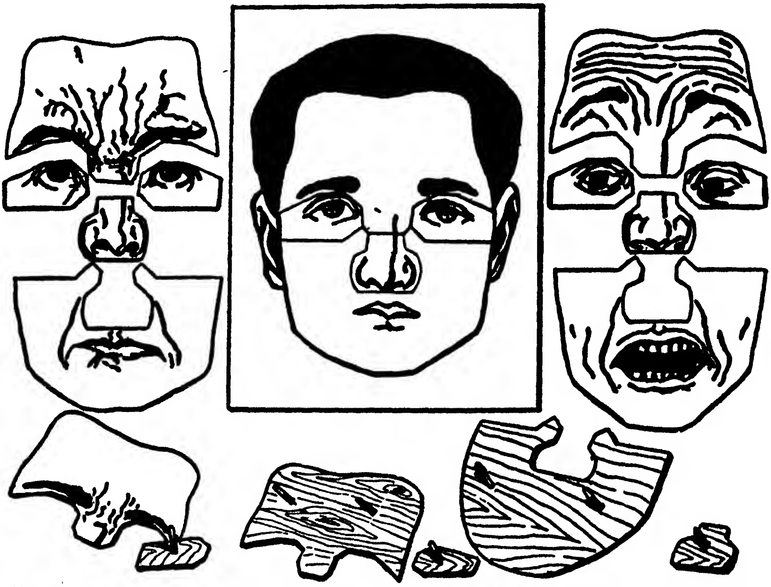

FIG. 25.—Guilford's facial model for studying facial expression of emotions. (*Courtesy of C. H. Stoelting Company.*)

teristic set of muscular contractions relating to salt. It must be borne in mind continually that each of these basic and rather generalized patterns is capable of an infinite number of specific applications on the basis of one's social training.

Guilford, following the lead of Titchener, has devised a new model of the face in which the eyes, nose, mouth, and brows may be altered independently so as to study

the influence of each. It may be noted that psychological studies based upon the use of such a model (shown in Fig. 25) bear no relation to the old pseudo-science of physiognomy, since we are studying here the meaning that has been socially attached to various forms of facial movement. In other words, this study is still a psychological study of action.

F. H. Allport, in his *Social Psychology*, offers a classification of facial expression on a sixfold basis as follows: (1) pain—grief, (2) surprise—fear, (3) anger, (4) disgust, (5) pleasure, and (6) various attitudes. This earlier study was somewhat more subjective in its approach than is that of Guilford but still showed a remarkable insight into the ways in which the facial muscles are actually used as a means of emotional expression.

Emotions Classed as Pleasant or Unpleasant. The genetic study of emotions demonstrates again the presence of two fundamental types of emotional response. These are the pleasant and the unpleasant responses. They are related to the operation of the craniosacral and of the sympathetic divisions of the nervous system. Two fundamental varieties of facial expression correspond to the pleasant and unpleasant emotions.

This significant relationship between the operation of the sympathetic division and that of the craniosacral division has been reported by F. H. Allport in his studies showing that a stronger stimulus is required to arouse the sympathetic than to arouse the craniosacral division. A young child, for instance, can be made to laugh more easily and will respond with a laugh more

quickly than he will to a stimulus calling forth crying. The reason for this is that, in the case of the sympathetic division, the stimulus, in passing from the cerebrospinal, or voluntary, to the autonomic system must pass through an additional set of ganglion cells that offer resistance to the nerve impulses; whereas fewer such ganglion cells are present in the craniosacral division.

The practical implication of this rather technical point is that the unpleasant or emergency emotions, as Cannon calls them, are intended to be used only in truly critical situations. If they were to be called out frequently and on slight pretense, the organism would shortly be reduced to a state of exhaustion by the excessive strain on its physical resistance. This, indeed, is exactly what happens with persons who have formed the habit of responding emotionally to trivial situations. This neurological picture also explains another phenomenon observed in daily life, *viz.*, that situations that call forth laughter, if continued, may cause the laughter to change to crying. Probably all of us have "laughed until we cried." The explanation is that the situation that first called forth laughter became more intense through repetition so that enough energy was finally generated to break over the resistance offered and thus set the sympathetic system in operation. As a matter of fact, it might be that a truer picture of emotions would be gained if we classified them as mild and pleasant versus violent and unpleasant emotions. Within these classifications there is no doubt that the various subtypes of emotional response are quite largely matters of social stereotypes growing out of our cultural condition-

ing, rather than patterns of response inherent in the mechanism controlling emotions.

There are probably considerable individual differences in native emotionality; this means that just as there are differences in the way in which the nervous system functions as related to intelligence, so there are persons whose autonomic systems are more easily set off than others. We cannot be sure how much of these individual differences are inherited and how much are due to differences in social training, but we can be sure that they do exist in the adult. Whether we agree with Rosanoff, Jung, and others that differences in emotionality are results of hereditary traits, or with Watson and his followers that they result almost entirely from social training, the fact remains that the only control we can exert over the situation comes through social training. If it be true that some persons are born with less emotional stability than others, it means only that exceptional care must be exercised in their cases so that social conditions may not aggravate their situation.

It may be pretty confidently stated that the vast majority of nervous breakdowns and of emotional maladjustments result from unfortunate social experiences. Most serious among these are the instillation of needless fears in children. The fear of the dark, of policemen, dogs, snakes, and hundreds of other objects provides a rich basis for later emotional instability. The approach to the mental hygiene of emotions involves the avoidance of emotional conditioning of the unpleasant sort wherever possible. Emotions tend to sidetrack reasoning processes and to drive us into situations that

cannot be harmonized with social needs. Practically all normal people have little clusters of useless emotional habits that rob them of their strength and cause them to waste what strength they have in unnecessary or injudicious action.

In psychopathic individuals these same expressions of uncontrolled emotionality carry the individual to the point of becoming an actual menace to himself and to society. The normal adult, if he has already been made the victim of unfortunate emotional habits, can frequently right himself through a careful analysis of them in connection with the reading of such helpful discussions as those found in the bibliography at the close of this chapter.

Emotions versus Reason

Our studies have shown that during emotional responses the autonomic nervous system is in control. This usually means that the action of the central nervous system is impeded. Consequently, the reasoning processes, together with many finely coordinated voluntary movements, are blocked. Speaking biologically, we say that emotions are valuable in meeting crises of a gross physical nature. Emotions release great amounts of energy, but the energy can usually be used only in gross physical activities. The problems that arise in modern life rarely lend themselves to solution through physical combat.

Our problems must be solved through the use of reason, tact, and diplomacy. These are the very processes that are inhibited by emotional response. In

modern society it is usually impossible to express violent emotions. Persons who do give vent to their emotions are likely to be thought of as vulgar, crude, and lacking in social training. Emotional responses do well up in us, however, and, since they find no adequate expression, their results are to cause pent-up emotions, unused energy supplies, and other physical conditions that may lead directly to nervous troubles.

At first glance it would seem that, although emotions may have been excellent in primitive life, our problem today would be that of eliminating emotions altogether. It would seem that a life governed entirely by reason might be not only successful but ideal as representing the exclusive use of man's higher capacities. Unfortunately, the problem is not quite so simple. The refined processes of modern life, particularly the long grinds of continued work, require energy sources. Uninspired work becomes mere drudgery. Creative work, not driven by some ample source of power, may never reach genius. Above all, our sentiments, ideals, and emotional experiences are the factors that lend richness and color to our lives. A life of pure reason might be a very efficient one, but it probably would not be very thrilling.

As is usually the case in such matters, the middle-of-the-road position is perhaps the ideal one. If we can train ourselves to avoid the more violent outbursts of emotion and yet maintain the stimulating qualities that certain emotional responses bring, we shall probably be happier. We should strive, at all events, to have our reason dictate to our emotions, rather than the opposite. A spirited horse is a splendid and inspiring object, but,

if it gets out of hand, the damage it can do may be exceedingly great.

In modern life we are frequently aroused to mild emotional states and then prevented by society from giving natural expression to these states. This has led to the development of a number of substitute responses. Perhaps the most common of these is worry. Worry consists essentially in the repeated performance of a series of nonadjustive activities. Worry frequently takes the form of a repeated chain of linguistic responses or, in other words, constantly "repeating" a situation to oneself, or even repeatedly going over the instance and items of a discussion with some friend. If the repetitions bring forth no new solutions, they serve merely to dissipate the pent-up energies of the subject. In a similar way a great many of our meaningless stereotyped actions, such as "doodling," play a role in draining off energies. It is probable that such activities as smoking, strumming on tables, playing with one's watch chain, or drawing pictures in telephone booths all have a common core as releases for energy that would normally flow outward through now-forbidden paths.

Joël Behavior Maturity Blank

Important among the tests that have been devised to measure the degree of emotional stability is the Joël *Behavior Maturity Blank.*[1] This test defines behavior maturity as "grown-upness" or freedom from childishness. In operation this comes to mean the ability to restrain impulsive and emotionally motivated actions

[1] Joël, W., *Behavior Maturity Blank*, Gutenberg Press, Los Angeles, Calif.

and to substitute actions directed by the requirements of reason. The test consists of 68 questions touching on matters of actual conduct in daily life. For instance, Do you get sulky if you don't get what you want? Do you find it difficult to sit perfectly still for any length of time? Do you like to show off? Do you enjoy practical jokes played on others? Questions of this type, if answered frankly, will tend to show the degree to which one has disciplined oneself. Joël has found that there is a progressive increase in score with the advancing age of children and has found that the test not only may be useful in calling young people's attention to their need for greater social sophistication, but that in conjunction with individual interviews it can frequently help in spotting the specific manifestation of emotional or other personality difficulties.

The importance that may be attached to this matter of emotional or behavior maturity is indicated by the evaluation of Garrett[1] who expresses it as his opinion that "the success or failure of an individual in his professional or occupational career—and of course in his private life—is contingent upon emotional balance as much as, if not more than, upon intellectual ability."

Feelings

The study of feelings is closely related to the general problem of emotions. As a matter of fact, the current view is that feelings are merely mild emotional states. The internal changes that give rise to feelings are so slight and at the same time so complex that they cannot

[1] GARRETT, HENRY E., *Great Experiments in Psychology*, rev. ed., p. 317.

be analyzed even introspectively. Attempts at objective measurement through the use of instruments have likewise proved to be of questionable use.

It is now common to classify feelings according to a two-dimensional theory, *viz.*, that all feelings are either pleasant or unpleasant. This classification is a simplification of the older tridimensional theory of Wundt who held that feelings could be classed according to three pairs, *viz.*, strain—relaxation, excitement—calm, and pleasant—unpleasant. One may infer that in each of these pairs one component (relaxation, calm, pleasantness) is associated with craniosacral-system responses, whereas the others (strain, excitement, and unpleasantness) are related to the activity of the sympathetic division of the autonomic system.

Current theories stress what is called "hedonistic tone." The problem here is whether or not a given action or sensory experience carries with it a positive or negative hedonistic quality. Probably much of our work on impulses, aptitudes, and even social intelligence relates to this question of the type of hedonistic tone aroused by a given situation.

Hedonistic Tone in Colors. A concrete illustration of the role of feelings in life and also of the psychological techniques used to measure it is afforded in studies of color preference. The standard procedure is to pair each of six colors with each of the others and to have the subject judge which color in each pair is the more pleasant. The results of studies made by this method of paired comparisons show that, for both men and women, blues, reds, and greens usually hold the posi-

tions of first, second, and third choice. The most common opinion is that such preferences are determined by teaching so that in a definite culture pattern the order of preferences might be different. This elementary experiment can be modified so as to answer the practical question as to which of several combinations will be the most effective when used in color advertising. Classroom demonstrations carried out by the writer and his colleagues have shown that frequently one or two advertisements out of a group of six all taken from a current issue of *The Saturday Evening Post* may be chosen to the almost complete exclusion of the other four or five. Many times two or three will be given first choice by no one at all! When one learns that one insertion of a single-page color advertisement in *The Saturday Evening Post* now costs $8,500, it will be appreciated that the question of determining the most pleasing color combinations becomes a genuine one.

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Chapter 8

THE PSYCHOLOGY OF EFFICIENT LEARNING

LIFE is a continuous process of adjustment on the part of the individual to his environment. This point of view has been stressed throughout the text up to this time. We have seen that the success of an organism is measured by the effectiveness with which it can adapt itself to new conditions in the world around it. We have also seen that in the human being the process of adaptation involves a modification of the action of the individual himself. Modification also occurs in lower animals, although in some cases where the animal is very highly specialized, learning is of less importance than in the case of human beings.

Since learning is the all-important problem in human adjustment, it becomes important to understand something of its nature and to inquire into the conditions under which it takes place most effectively. Learning is, then, the same as habit formation. The chapter dealing with the learning process might well be referred to under the topic of How to Form Habits Effectively.

Three conditions are essential if learning is to take place. First, there must be a stimulus to set off the activity. This stimulus may be a change in the external environment, or it may be some changed condition

inside the animal, such as hunger or thirst. Were it not for the presence of some stimulating force, there would be no activity and hence no possibility of new or different activity. The second condition for learning is that there must be several possible means of reacting. Obviously, if the animal were stimulated to action and only one possible course of action were open, no learning would be involved. This is approximately what happens in the case of simple animals or those provided with a highly specialized structure. If the structure is so specialized that it can scarcely operate in any other way than the correct one, there will be little in the way of learning. In the case of human beings, as we have seen, the animal is so unspecialized that there are usually a great many possible ways in which it can react. The third condition essential for learning is that the correct response must not have previously been established. This is merely to emphasize the obvious fact that if the response is already appropriate nothing new is acquired in performing it.

Given these essential conditions for learning, how does the process take place? Older psychologists used the term "association" to explain the phenomenon, whereas psychologists today use the term "conditioning" to refer to much the same process. We have seen that the nervous system is so arranged as to make it possible for any incoming impulse to pass outward by means of synaptic connections over any of a great many motor pathways. The process of conditioning involves the connection of a given incoming impulse with a new outgoing or motor pathway.

Pavlov. The way in which this takes place can be best illustrated by an example from the work of the famous Russian psychologist, Pavlov. If a dog be presented with food, it will experience a salivary response just as we humans would. Pavlov's contribution was to investigate the conditions under which some new incoming stimulus can be made to arouse this same salivary response. He found that, if he rang a bell each time just before the

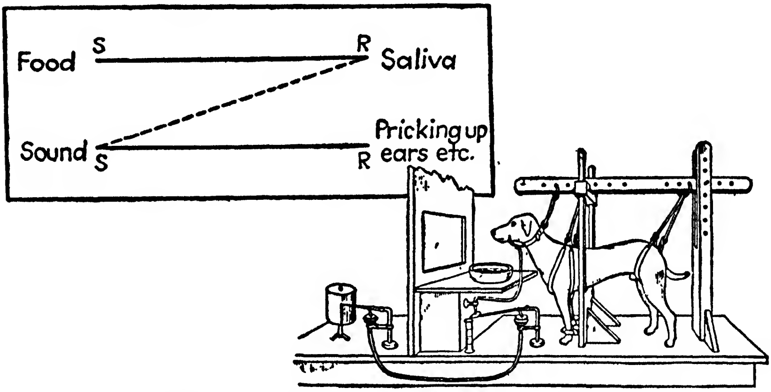

FIG. 26.—Diagram illustrating the operation of the conditioned reflex.

food was presented, eventually the animal would salivate when the bell stimulus alone was presented. Figure 26 shows in diagram form the process that takes place. The normal stimulus *S* gives rise to the normal salivary response *R*. The conditioned stimulus *S* normally leads to some indifferent response, such as turning the head or pricking up the ears, marked *R*.

Now, if these two stimuli are presented together, both neural processes seem to become intertwined, as indicated by the dotted crossline. It should be noticed in passing that although we are interested in the bell giving

rise to the salivary response, it would be equally true that the food would come to give rise to certain indifferent responses. The important thing is that a stimulus has come to give rise to a response which did not previously follow from it. Now that Pavlov has demonstrated these connections for us, we can safely point out that not only dogs but humans as well exhibit exactly the same conditioned response. Every one of us has experienced a preliminary "watering of the mouth" upon hearing the dinner bell.

Trial and Error in Learning

The most common explanation of the process by which these new conditionings are effected is that they result from the more or less blind trial-and-error activities of the animal. If an animal be presented with the several alternatives as suggested in the preceding paragraph, it will proceed to carry out the various possible responses. If the first response tried does not bring satisfaction, it will try another response, and so on, until it comes upon a response that seems to fairly well meet the needs of the situation. This latter response will tend to be utilized again, and repeatedly on successive occasions, until it becomes thoroughly established in the system of the animal.

Much of our knowledge of the conditions under which learning occurs has resulted from the studies on the trial-and-error learning of animals. Professor Thorndike in America and C. Lloyd Morgan in England are the two great figures in this connection. The early studies of animals centered around their efforts to escape from puzzle boxes and from mazes.

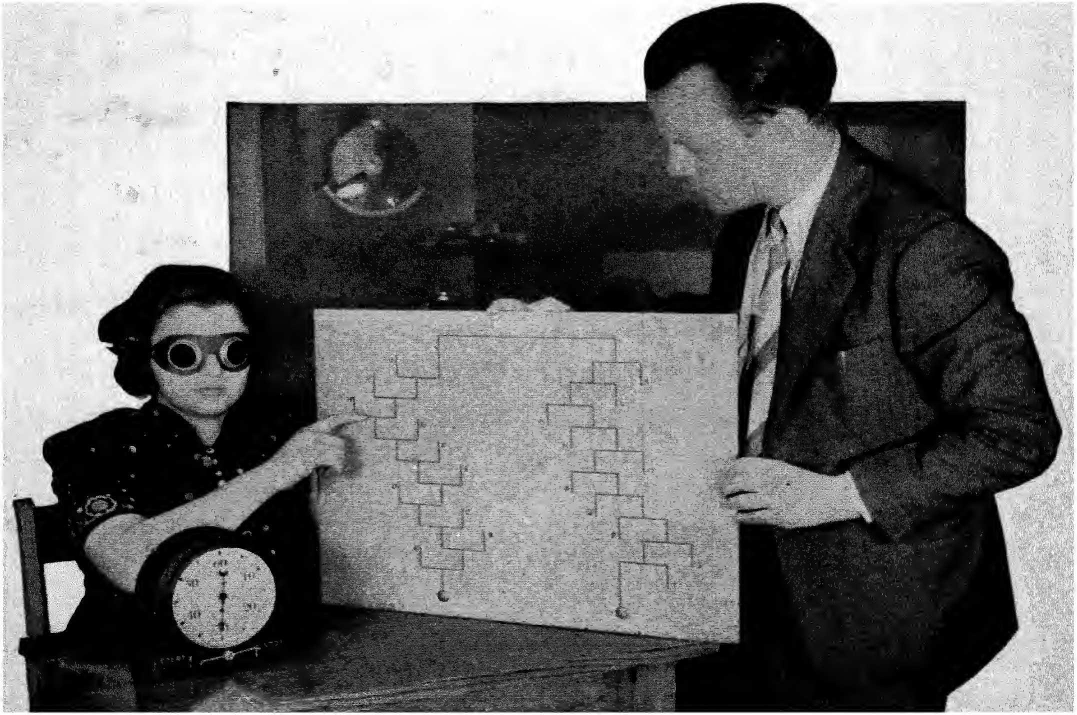

FIG. 27.—Learning a finger maze.

(Facing page 210.)

The animal, in the case of Thorndike's early work—a cat—is placed in the box with a tempting bit of food outside. The cat will, of course, scratch and meow, roll over, rub its head, and do all the things that it can do in a more or less blind effort to escape. In the course of its scratching, it will eventually strike the hidden catch, and so the animal will escape. Next time the animal may confine its efforts more particularly to the corner of the box in which it found itself when it escaped the first time, and so will the more quickly trip the trigger a second time. In this way the cat finally comes to move directly to the trigger and set it off without any preliminary efforts. When the cat has come to do this every time without error, it is said to have completed the learning process.

In a similar way, baby chicks, white rats, and a variety of other small animals were studied as they attempted to find their way through twisted pathways called "mazes." These pathways have many blind alleys and correspond pretty well to the mazes that most of us have seen in the fun houses in amusement zones. Placed in these mazes the animal will run up and down pathways more or less blindly, entering blind alleys, retracing his steps, but eventually coming to the end of the path and food. As in the case of the puzzle box, the blind alleys and false retracings of steps are gradually eliminated until the animal runs without error, and by the shortest route, directly through the maze.

Larger animals are also occasionally used for studies upon the learning process. Monkeys and apes have been favored subjects for this work. Here the animals are of a higher level of ability, and the learning process is likely

to be more complex. Instead of teaching the animals to find their way through mazes, they are taught to obtain food through the use of tools, such as jointed sticks or through the piling of boxes one on another. They are also required to learn which of several possible doorways will lead to food.

The results of these studies on higher animals have led one group of psychologists called the Gestalt psychologists to place a somewhat different interpretation on the learning process. They feel that the important thing in the learning process is the attainment of an "insight" into the situation. They believe that once this insight is gained, the learning takes place almost at once. Exponents of the trial-and-error theory argue in reply that the trial-and-error activity is essential to gain what is called "insight."

Students should avail themselves of an opportunity to follow this controversial issue further than can be undertaken here by reading some of the references listed at the close of this chapter.

Characteristics of the Learning Process. In order to trace the progress of learning, graphic methods have come to be employed. The learning curve is a line graph which shows at a glance any change in the length of time or in the accuracy with which the movements involved in any bit of learning are made. Figure 28 shows a typical learning curve of a cat finding its way from a puzzle box. Similar curves can be prepared in the study of any learning process.

Curve of Learning. Learning curves show certain fundamental characteristics which contribute to our

understanding of the learning process. In the first place, there is usually a rapid initial improvement in both speed and accuracy. This probably means that certain gross inaccuracies are removed at the outset, whereas the smaller errors depend upon further exploration for their discovery. Secondly, learning curves are not, as a rule, uniform in their progress. An animal may make an exceptionally good run through a maze and

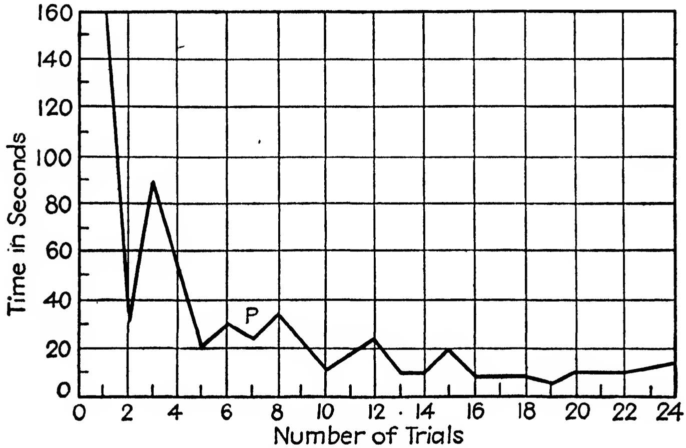

FIG. 28.—The learning curve of a cat. (*From Thorndike.*)

the very next time show an extremely bad record. This fact of irregularity seems to argue strongly in favor of the trial-and-error nature of learning. A third characteristic of curves of learning is that they frequently show "plateaus." These plateaus, such as shown by the letter *P* in Fig. 28, represent periods during which no improvement can be observed. It may mean that in the trial-and-error process no significant improvements have been stumbled upon. It may also mean that minor modifications are taking place, no one

of which can bring a net improvement until it is coordinated with other minor changes. In any case, the plateau is frequently followed by a fairly significant improvement in the learning process.

A final characteristic to be noted is that if the learning process continues long enough, the curve representing it comes to be almost a straight line. This situation indicates that the process has approached what we call the "physiological limit." By this condition we mean that all the significant errors have been eliminated and that the animal is performing the act with approximately as much speed as the contraction rate of his muscles will permit. It will be understood that learning cannot proceed beyond this point. As a matter of fact, it is frequently not economical to try to carry it even to this point.

Laws of Learning

The conditions under which learning takes place most effectively are usually listed under a set of formal laws. These were originally formulated by Professor Thorndike.

Law of Exercise. We have already seen that activity tends to result in learning. The law of exercise may be stated as follows: Whenever a reaction is practiced, the connections in the nervous system are strengthened. Under this general heading, we find the laws of use and disuse. Naturally, the more often an act is used, the more firmly it will become entrenched in the system. On the other hand, if an act is not practiced for a given length of time, the strength of the connections will be

lessened. Relating to this same idea are the principles of recency and frequency. The more frequently an act is exercised, the stronger will be the connections. Recency also determines strength of connections in the sense that more recent actions will leave their trace more strongly in the nervous system than will acts not performed for a long time.

Applications of the law of exercise are found in the principles of contiguity and intensity. The principle of contiguity is that acts performed in close time or place relationship to each other tend to become associated. When this happens, the acts may come to operate as one act. The principle of intensity is closely related to that of frequency. Intensity fixes habits through the more vigorous manner in which an act is performed. Thus, we may learn a habit in one trial if the conditions under which the learning takes place are sufficiently intense. An emotional element in a situation most frequently is the factor providing the intensity. It is well to know of these sublaws, but also to remember that they describe the conditions under which the general concept of exercise works.

Law of Effect. Exercise does not operate alone in determining the rate of learning. If our learning efforts bring satisfaction, the thing being learned will be acquired more rapidly than if the efforts are accompanied by annoyance. This gives rise to Thorndike's concept of "satisfiers" and "annoyers." In the case of annoyance, it is probably not exactly true that we fail to learn, but rather that the "annoyers" cause us to learn something other than the conduct under consideration.

A famous early study on learning in the perch illustrates this point. A perch was placed in a glass aquarium and fed upon minnows. Naturally, the fish darted toward the minnow as soon as the latter was placed in the tank. The experimenter then placed a glass partition in the aquarium. Thereafter the minnow was placed on the opposite side of the partition from the perch. At first the perch would dart at the minnow with great vigor, only to receive a bump on his snout as he struck the glass partition. Gradually the perch came to the point where the sight of the minnow would cause him to turn and swim away from the minnow rather than to attack him. This continued to be true even when the glass partition had been removed. In terms of the law of exercise alone, each of the early attacks on the minnow should have fortified the action and thus made the habit still more firmly entrenched. Actually, the unpleasant results of the contact with the partition not only undermined the original act, but led to the establishment of the new turning-away movements.

However such acts may be explained neurologically, the important thing is that the law of effect does influence the learning rate very greatly. Animal psychologists have long used the hunger urge as a means of increasing the rate of learning. The rate of learning is speeded up because of the pleasant effect of successfully solving the problem so as to get the food given at that time.

Studies by Elliott on the rate of learning in white rats when using various types of rewards are interesting

in this connection. In Fig. 29 are presented the learning curves of two groups of rats. One group—the "control" group—was given a uniform diet of sunflower seeds. Their progress was altogether normal, as shown by their learning curve. The other group was started

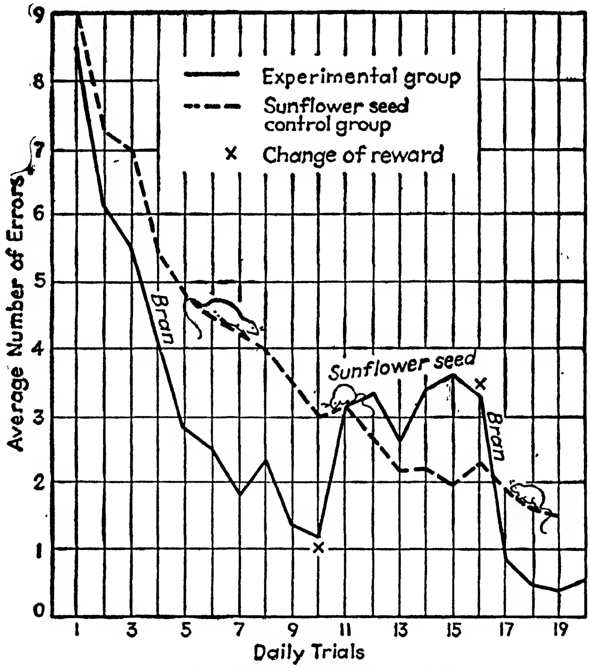

FIG. 29.—The relation of the hunger urge to learning. (*Adapted from Elliott.*)

off with bran (rats are very fond of bran) as the reward in the early trials. The effect of this superior reward is clearly shown on the early progress of the experimental group. During the second part of the experiment, the reward was changed from bran to sunflower seeds, with the resulting loss in progress, indicated by the curve. In the final stages the reward was shifted back

to bran again, and the animals almost immediately spurted to a new level of perfection. We see, therefore, that not only are things pleasant or unpleasant, but that some rewards may be much more effective than others.

In connection with human learning, psychologists are becoming more and more insistent upon the importance of the proper use of rewards to motivate learning. Every mother knows, of course, that it is easier to get her child to do his work if he is to receive a stick of candy upon its completion. College students are supposed to be motivated by some abstract urge toward excellence. Those who achieve excellence are rewarded by receiving scholastic honors. It has been suggested that, although the Phi Beta Kappa key constitutes an excellent reward, a more material reward might have a still greater effect. If, for instance, we were to reward students attaining Phi Beta Kappa quality with a cash prize of $10,000 upon graduation, there is little question but that the amount of such high scholarship would be greatly increased.

A practical use of this principle has recently been made use of by the government in connection with its NYA work. Federal monies are made available for qualified students who are willing to work under the guidance of their instructors or others. The regular rate of remuneration has been $0.36 per hour. Newly completed plans offer to the student a remuneration rate of $0.50 per hour if his college scholarship average lies above a certain point of excellence. There can be no doubt as to the motivating effect that this will have upon scholarship. The whole important problem of

motivation as related to learning is involved in this question of rewards.

Thorndike has said, "When an organism is ready to react, to react is pleasant." This statement ties the problem of readiness to the law of effect. The facts are that when an organism is ready to learn, it learns more quickly than it would otherwise do. By "readiness" we mean the elimination of as much as possible in the way of distraction and the attainment of as much as possible in the way of preliminary orientation. It may even be that the matter of readiness covers much of the ground included in what the Gestalt psychologists refer to as "insight."

The strictly physiological element involved in readiness is the matter of muscle tonus. We have already learned that healthy muscle is never completely relaxed. Some of the muscle fibers of each muscle group are always in a state of contraction. The point at which enough fibers come into action to produce an observable, *i.e.*, overt, movement is called the "threshold." The nearer a muscle group approaches the threshold without going over it, the easier it will be for the muscle to react when the time comes. When the tonus of large numbers of appropriate muscles is brought near the threshold, there may be involved very little in the way of actual exercise to fix the habit. It is certainly true that the preliminary change in the nerve paths in establishing muscle tonus is itself a form of learning. This is perhaps what is going on during the periods preceding the insight and also during the time in which the learning curve is said to be on a plateau.

From a practical standpoint, we see that the important thing is to develop an interest in and a tenseness toward the subject in hand. Readiness viewed as a matter of tonus becomes practically synonymous with the whole idea of attention. We shall have several occasions to refer to the concept of attention later on in our study.

Nerve Function in Learning

Two outstanding theories have been developed in an attempt to explain what goes on in the nervous system during learning.

Synaptic-resistance Theory. The older theory, and the one still most widely taught, is that during the learning processes the resistance to the passage of nerve energy is changed at the synapse. An analogy may help to illustrate what is meant. Nerves have been compared to little streams of water. The more the water flows through one of two alternate ditches, the more likely it is to continue flowing through it.

The whole nervous system viewed in terms of the synaptic-resistance idea has been compared to a telephone system. The incoming telephone line corresponds to the sensory neurons. The wires leading from the telephone operator to the receiving party correspond to the motor nerves. The function of making and breaking connections at the synapse corresponds to the plugging in or out of the wires in the switchboard. Like most analogies, this one has descriptive value but may lead to false notions if taken too literally.

It is not our duty here to decide among the various theories as to what happens during learning. We may point out at this time, however, that the synaptic-resistance theory has been vigorously attacked from many angles in recent years. Professor Lashley, in his address as President of the American Psychological Association, has stated, "There is no direct evidence for any function of the anatomical synapse. There is no evidence that synapses vary in resistance, or that, if they do, the resistance is altered by the passage of the nerve impulses."

Theory of Frequency. Studies of nerve currents have recently been made, using the action-current machine, which is a device using radio vacuum tubes to amplify or build up the faint nerve currents of the body. These studies have shown that nerve impulses take the form of tremendously complicated patterns. Their appearance is not unlike the appearance of sound waves when the latter are projected onto a screen. We are not yet able to read these patterns directly as messages of various sorts, but we do have strong reason to believe that the differences in the pattern have something to do with the messages that are being relayed.

Out of these nerve studies has come the theory of frequency. This theory can best be explained by means of another analogy. As the telephone system illustrates the synaptic-resistance theory, so the action of the radio illustrates the theory of mass action. Assume that we have three broadcasting stations and three radio receivers in a distant room. Now, if all three sets be

tuned to station *A*, they will play when station *A* broadcasts and will become silent when station *A* ceases to broadcast, even though stations *B* and *C* are broadcasting full strength. Remember that when stations *B* and *C* are broadcasting, the radio waves do actually reach the three radio sets. They reach them, enter into them, but do not reappear in the form of sound, because they are not tuned to the "motor" side of the set. Continuing the illustration, we may quickly tune the three sets so that they will respond only to *B* or *C*, or again so that one of the sets will respond to each one of the broadcasting stations. In the latter case, if the stations *A* and *C* become silent and *B* broadcasts, receiving set *B*-1 will play. Now, without touching any of the three receiving sets, it is possible to start and stop them by turning the broadcasting sets on and off. All these illustrations are intended to show how it may be possible that learning is a matter of adjusting the various nerves to respond to various frequencies in the nerve energy.

It is even possible that the muscles themselves, like the receiving sets, respond only when nerve energy comes to them at the proper frequency. We do know definitely also that nerve energy once aroused in the central system spreads to some extent over the entire body, instead of passing out only over selected paths as used to be thought. In this same general connection, we might refer again to the studies of Lashley, in which he has proved by experiments upon the brains of rats and other animals that the so-called "pathways through the brain" are far less specific than was once thought.

Getting the Most out of Your Memory

The study of the laws of memory was begun by the German psychologist Ebbinghaus. His remarkable studies, published in 1885, were carried out over a period of more than 10 years. He used but one person—himself—as subject, but so careful and objective was his method that practically all his findings are still valid today. The fine accuracy of his results was probably due in part to his use of "nonsense syllables" invented by him to supply scientifically satisfactory materials for memory work. Nonsense syllables are artificial constructs usually of either three or five letters, such as mib, vof, bax, etc. These syllables meet the demand for a memory material that will be scientifically satisfactory in at least three ways: (1) they will be equally unfamiliar to all so that no ready-made associations will exist to favor one or another list; (2) they permit exact quantitative measurement by using a given number of three- or five-syllable units; (3) nonsense syllables are lacking in rhythm that might, as in poetry, favor one set of memory materials over another. The following principles growing out of his work deal with the efficiency of memorizing and should be applied by every student in his own study program.

Reading versus Recitation. Among the experimental studies underlying the principle of studying a thing the way you will use it are those dealing with the relative values of reading versus recitation as study methods. The results of studying materials by these methods may be summarized in the statement that *the greater the*

amount of time devoted to recitation the greater the percentage of the lesson recalled. Table 9 shows the results of a study by Gates in which both nonsense syllables and related words were studied by the two methods.

The psychological situation underlying these results is the fact that silent reading can never be a means of reproduction. In reading material, therefore, we are not performing a process in the way it will have to be performed later. In studying by the recitation method, we are using in our study the motor organs of speech as they will be used later in reproducing the material. In other words in the recitation method we are learning the thing as we shall use it.

TABLE 9
Recitation versus Reading
(From Gates)

Material Studied	16 Nonsense Syllables, Per Cent Remembered		5 Biographies, Total of 170 Words, Per Cent Remembered	
	Immediately	After 4 hours	Immediately	After 4 hours
All time devoted to reading	35	15	35	16
1/5 of time devoted to recitation	50	26	37	19
2/5 of time devoted to recitation	54	28	41	25
3/5 of time devoted to recitation	57	37	42	26
4/5 of time devoted to recitation	74	48	42	26

Whole versus Part Learning. Is it better, in memorizing a given number of verses, to study them verse by verse or to study the poem as a whole? Applying our "key" principle to the problem the questions become, "Will I be reciting the material as isolated verses or as a complete poem?" The answer is obviously the latter. Psychological studies show quite definitely that this

logical conclusion is borne out in fact. Pyle and Snyder studied the amount of time required to memorize various amounts of material by the two methods. These results, showing a constant factor of advantage ranging from 10 to 20 per cent in favor of the whole method, are shown in Table 10.

TABLE 10

Learning Passages of 240 Lines by the Whole and Part Methods

(The whole method consisted of three readings per day till it could be recited; the part method in memorizing 30 lines per day until it could be recited. From Pyle and Snyder.)

NUMBER OF LINES	TIME REQUIRED BY PART METHOD, MINUTES	TIME REQUIRED BY WHOLE METHOD, MINUTES	PERCENTAGE OF SAVING BY WHOLE METHOD
20	16	14	12
30	27	24	13
40	39	35	9
50	49	44	12
60	81	64	22
120	169	140	17
240	431	348	19

Length of Material. Ebbinghaus showed that the difficulty of memorizing increases much more than proportionately as the length of material increases. Thus although it required an average of 6.8 seconds per syllable to memorize a list of 12 nonsense syllables, it required an average of 17.6 seconds per syllable to memorize a list of 24 and 22.0 seconds per syllable to memorize a list of 36. In this example doubling the length of material resulted in using almost three times as much time per syllable. From this basic experiment we derive the principle that study units should be relatively short. From other studies it has been established that the ideal study period does not exceed 30 minutes. This does not mean, of course, that one can

study only 30 minutes per evening, but it does mean that one should study not more than 30 minutes on one topic and then shift after a brief rest to some other object and study it for 30 minutes.

Reviewing and Cramming. The second principle growing out of Ebbinghaus's work has to do with what psychologists call spaced versus unspaced learning. Most of us sit down to a given lesson with the determination that we shall not leave it until we have mastered it. This is usually the wrong procedure. Many studies unite in showing that distributed study in the form of frequent reviews is far more efficient than concentrated study. Thus Ebbinghaus found that, whereas it took him 68 repetitions to learn a 12-syllable list when the work was done all at once, the same task spread over three days required only 38 readings. Another study showed an average gain of 15 per cent in efficiency through properly distributed study efforts. The principle underlying this problem is similar to that found in studying muscular work. This principle is to keep the muscle working in the early stages of the fatigue curve and has been studied in the third chapter.

The importance of frequent review is related also to the extreme rapidity with which material once learned is forgotten. Ebbinghaus showed that the curve of forgetting is approximately the obverse of the curve of learning. We forget very rapidly at first and then more and more slowly. For instance in one study, 56 per cent of the material was forgotten in 1 hour following learning, whereas only 10 per cent more was lost in the succeeding 23 hours. Here review helps because it permits

us to pick up these remnants and reestablish them before they become entirely lost.

Overlearning Pays! Related to the question of rate of forgetting is another principle: that of overlearning. Ebbinghaus's work on the rate of forgetting used the standard of one correct repetition. If, instead of being satisfied with the ability to repeat something once correctly (which is the standard that most students

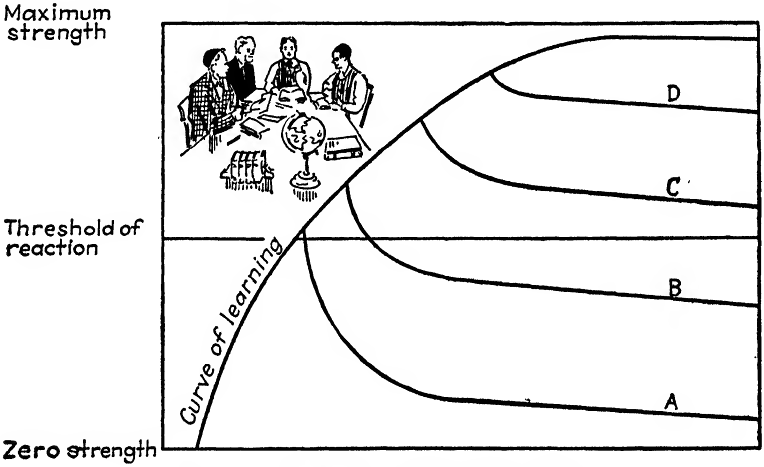

FIG. 30.—Overlearning pays! (*From Gates.*)

use), we were to continue studying beyond this point we would find that the loss through forgetting would be very much smaller.

Figure 30 above shows the curve of forgetting as related to different amounts of overlearning. Curve *A* in which the learning was just up to the threshold shows a very rapid loss. It falls below the level of ability to correctly reproduce almost immediately. Curve *B* in which the learning has been carried beyond the thresh-

old shows a slower rate but even here the curve falls below the line of perfection quite soon. In Curve *C* the learning has been carried far enough so that correct reproduction remains possible for a great length of time. Probably for most kinds of work overlearning to the extent indicated by Curve *C* would prove to be the most efficient. Group *D*, in which there is a very great amount of overlearning, would be operative only in such things as walking, talking, driving a car, or other processes that we practice continually. Notice how little additional work is required to overlearn material so it will not be forgotten once one has the studies up to the threshold. The proper use of overlearning is one of the most effective principles that the student can apply.

Reading

As the use of written language increased, especially following the invention of printing, the ability to read efficiently assumed tremendous importance. The mechanics of reading is very simple though different from the process usually imagined by the person who has not studied it. The eye, like the camera, cannot photograph when either the eye or the object viewed is in motion. In reading, therefore, the eye does not sweep steadily along the lines. It moves, instead, by a series of shifts, with periods of fixation between. These shifts number from three to six per line, depending upon the skill of the reader. These moves, or "saccades," as they are called, occupy only from 5 to 10 per cent of the total reading time. The rest of the time is spent in fixations

upon the parts of the sentence. During these fixations the eye photographs the material.

The effectiveness with which one reads is indicated by the number of fixations that the subject has to make per line, together with the length of time for each fixation. Where reading skill is poor, the subject may find it necessary to stop and shift the eye back in order to photograph the earlier part of the line. This process is called "regression" in reading.

Exercise: Any student can easily study the mechanics of eye movement in reading by having an associate read a section from a book while the observer watches his eyes. If a mirror be fastened against the page of the book, opposite the page being read, the observer can follow the eye movements of the reader by looking over his shoulder. In this way it is easy to count the average number of shifts per line and also to note the presence of regressions.

The efficiency of the mechanical phases of reading usually reflects the literary background of the subject. Early students of reading skill sought to improve this ability by forcing a "speed-up" of the eye movements. These attempts were not particularly successful, and psychologists soon came to realize that the eye movements would take care of themselves if the perceptual background of the reader were improved. In other words, if a reader knows a great deal about the general subject of which he is reading, he can take in larger groups of material than he could if the subject matter were entirely strange.

This simple application of the law of attention points the way to the improvement of reading skills. Increase of vocabulary is probably one of the most direct and effective means of increasing reading speed. Extensive reading, especially forced reading, in which the reader consciously moves at top speed, is also valuable. Forced reading does two things: (1) it helps to increase the range of one's general information, and (2) it develops the habit of moving the eyes at the maximum rate consistent with understanding.

In addition to studies of the mechanics of reading, psychologists have developed very accurate tests for measuring the general efficiency of reading. Reading efficiency is frequently studied under two headings: reading comprehension, or understanding, and reading speed. Both are essential for general efficiency, and usually there is a fairly high positive correlation between the two. Every student should take such a reading examination and, if his score is low, should assume the responsibility of a definite program for reading improvement.

Learning in School

A number of practical hints can be given relating to the most efficient methods of study. These will obviously be of value only if translated into actual habits. Merely reading about improved study methods can do little or nothing toward raising the level of one's scholarship.

Budgeting Your Time. In the "Study Habits Inventory" devised by Wrenn, the item that shows the most serious effects on study is the following: "My time is unwisely distributed; I spend too much time on some

things and not enough on others." Failure to budget one's time usually means overemphasis on the subjects one likes and finds easy, with too little time on the harder and less tasteful subjects. This is, naturally, the reverse of the order that should be followed.

Bird, in his *Effective Study Habits*, has worked out a form in which one's whole schedule of activities can be indicated. Time can be allotted for class attendance, for study, for recreation, and for sleep and meals. The important thing is that if such a program is worked out objectively there is a greater chance that the student will follow it faithfully. An adaptation of this chart may be obtained from your instructor. Every student who plans to reorganize his study habits should fill out this schedule very thoughtfully. Filling it out without following it will, of course, be a mere waste of time.

Use of the Library. It is not our purpose here to discuss techniques for using the library. The library itself is the proper place for such study. Librarians are always delighted to find students who are sufficiently interested to want to go beyond the usual hit-or-miss methods of finding books and of finding materials available in books. An educated man is not a man who knows everything, but rather a man who knows where he can find the information he needs. Modern knowledge with its masses of technical information has become entirely too complicated for any one person to carry around in his mind. As time goes on, the ability to use indexes for both technical and general reading and the ability to find technical information in reference works become increasingly important. Most students have failed to avail themselves of even the simple method of looking

for subject matter in the index at the back of books. Thirty seconds' examination of the index at the back of the book will usually tell you more about the treatment of a given subject than a much longer time spent in rummaging through the book itself.

Physical Conditions for Study. Much has been written on the importance of physical conditions relating to effective study. Such matters as developing the habit of working on a given subject at the same place daily, having a working place which is free from distractions, assuring proper temperature and lighting conditions are all important in improving one's study efficiency. Such things as keeping the table top clear of unnecessary materials but supplied with essentials in the way of pencils and paper are important. In spite of this fact, however, it is possible to overemphasize these mechanical features. The main value of stressing certain mechanical features is that they may come to act as conditioned stimuli in setting off your regular study procedures. Their actual importance is perhaps not overly great for the student who is seriously interested in his work. Some research has actually shown that study can be carried on more effectively in the presence of distracting noises. By effectively we mean only that a larger output per hour is accomplished. Further analyses show that the energy required for study under these conditions is also greater. We can all frankly admit, however, that only a few students are in danger of overdoing from the standpoint of their use of energy, so that the main thing becomes a determination to study under whatever conditions are available.

Lighting conditions are, of course, important since continued use of the eyes under poor lighting conditions will result in eyestrain. The various types of lighting are discussed in another chapter. The student would do well to refer to this section and then to study his own lighting system with a view to correcting possible defects in it.

Taking Notes. There is much difference of opinion as to the importance of and methods for taking notes. In terms of psychological theory, the central value of note taking probably lies in the process of translating the lecturer's ideas into your own method of expression.

Behind this lies the familiar notion that we learn by doing. To listen passively to a lecturer is one thing. To express his ideas in your own words is a much more active and quite different process psychologically. Following this lead we may arrive at some principles governing note taking. Notes should never be so voluminous as to be merely an attempt to copy down what the lecturer is saying. Unless your notes represent an evaluation, condensation, and reexpression of the lecturer's words they are likely to be of little value to you. For most people, notes taken in the form of complete expressions of ideas are more valuable than mere words jotted down. Students' notes, like stenographers', can become "cold." The habit of recopying one's notes is usually inefficient. The copying almost always degenerates into a mechanical process, and the idea that the notes are going to be recopied encourages carelessness in the original note taking.

What has been said of note taking can be applied also to outlining of books. Here, the danger of copying mere

facts or sometimes whole sentences is greater than in the case of lecture notes. The need of insisting that book notes represent one's own active treatment of the book content is imperative.

Studying Study Methods. Is it not strange that we have, each of us, spent 12 or more years studying and yet most of us have spent little or no time learning how to do this thing most efficiently? The same thing is true, of course, of most workmen in other fields. Almost no one analyzes his efforts, at work in industry, to see whether or not his methods are as efficient as they should be. We have already seen examples of the surprising improvements that may result when the psychologist undertakes such a study. The student should follow up this topic of study methods. The books listed at the end of this chapter are designed to be completely practical and are based on sound experimental treatments of the subject. A small amount of time spent in studying how to study should pay very large dividends.

SUGGESTED READINGS

BIRD, C.: *Effective Study Habits.*
CRAFTS *et al.*: *Recent Experiments in Psychology.*
GARRETT, H. E.: *Great Experiments in Psychology.*
GRAY, J. S.: *Psychology in Use*, Chap. 6.
HILGARD and MARQUIS: *Conditioning and Learning.*
MORGAN, J. J. B.: *Keeping a Sound Mind*, Chap. 12.
VALENTINE, W. L.: *Experimental Foundations of General Psychology.*
WOODWORTH, R. S.: *Experimental Psychology*, Chaps. 2, 3, 6, 7.

Chapter 9

SYMBOLS, SEMANTICS, AND PROPAGANDA

MOST of the material in group intelligence tests is related to the use of symbols. This is in keeping with the fact that handling symbols is probably the highest expression of human, as opposed to animal, ability. It is our ability to use symbols that makes us human.

Symbols may be defined as objects or activities that stand for something other than, and usually more important than, themselves. Symbols are frequently parts of objects or of activities that are used as stimuli to bring about the response that would be brought about by the original object or act. The sound of an automobile horn stands for the entire automobile. When we react to the horn by getting onto the curb, we are really reacting to the automobile, the presence of which the horn indicates. The printed word "home" is a conventionalized symbol that stands for a host of objects and activities.

Man has developed two important classes of symbolic devices. These are the systems of language and of mathematics. By the aid of words and mathematical systems, man has learned to handle thousands or millions of objects not actually present.

The psychological basis of symbolic activity is to be found in the conditioned reflex. We have already learned that when some new stimulus is presented with a natural stimulus, the former gradually comes to bring about the same response as the latter. The natural stimulus is usually some original object of activity. The conditioned stimulus is frequently a symbol. The operation of this may be nicely illustrated in connection with the snarl or showing of the teeth by dogs or other animals. It should not be supposed that the dog snarls or shows its teeth originally in order to frighten other animals. What actually happens is that the dog lifts its lips from its teeth so that when it bites it will not bite its own lips. So important is this need that nature has provided a special set of muscles to lift the lip out of the way. A dog that is about to bite will naturally lift its lips in this way just before it bites. Therefore, the animal that is being bitten will always see the exposed teeth before the actual bite. In terms of the conditioned-reflex diagram, the sight of the teeth is the conditioned stimulus that eventually comes to set off the response of fright (or attack) that would normally be set off by the bite itself.

In the same way the flag and many other symbols come to have their functions. The emotions related to patriotic behavior are originally aroused by the sight of marching men, the playing of bands, and the orations of statesmen. In all these cases it should be noted the flag is prominently displayed. By the same associative mechanism, therefore, the flag comes to be the condi-

tioned stimulus that sets off the emotional response we call the feeling of patriotism.

In connection with the emotion of love, some object of slight commercial value may come to be of tremendous importance, because it has been associated with, and thus stands for, all the emotional values attaching the giver of the object. Children frequently come to fear perfectly innocent objects, such as spoons, chairs, or even their toys, because these happen to be present at the time they experience some emotion of fright. In these cases the toy has become the symbol standing for the original emotion. Almost every person has certain emotional conditionings of this sort.

Language and Social Behavior

Language represents the most important class of symbolic activities yet developed by man. It is through language that man is able to do such an enormous variety of things. Language symbols are short cuts to action. The earliest forms of symbolic communication probably took the form of gestures. These arose through the accidental association of facial expressions or bodily movements connected with emotional or other action. Even animals exhibit the use of gestures to this extent. Thus, as Darwin long ago showed, snarling and showing the teeth in the case of dogs is a symbolic stimulus. That is to say, the snarl is a limited action that is actually the first step in the process of biting. The biological value of such a process is obvious. If by snarling the animal sets off the response of flight, it will be saved the exhaustion and danger involved

in actual combat. Most animals develop some form of fragmentary behavior that serves to communicate to other animals the nature of the action to be anticipated.

In the human being, the symbolic expression of emotion has been carried to great lengths. The sneer is a highly symbolized form of expressing the emotion of anger. It relates back to the snarl and showing of the teeth, as in the dog, and from there on to the action in the undignified days when men actually bit each other in combat. Such gestures as shaking the fist and withdrawing in horror have obvious relations to complete physical responses. Other gestures, such as holding out the arms as in greeting, are also recognizable as symbolic or abbreviated forms of social action.

In speech we have gesture carried to a very advanced state. Here the original overt activity has been reduced to a slight action of the vocal cords. Several theories have been advanced as to the origin of speech, and each of these theories covers certain aspects of the problem.

The interjectional theory explains speech as being the symbolic modification of natural sounds made by man. These sounds would include noises made during emotional experiences, such as shouts of rage, cries of pain, and grunts and groans, in connection with intense physical strain.

The onomatopoetic theory explains the origin of speech as being the imitation of sounds in nature. Onomatopoetics are frequent in adjectival expressions, such as the "rippling" brook, the "boom" of a cannon, the "roar" of a lion, and the "zoom" of a bullet. Allport has pointed out that these theories explain very

well certain early stages in the development of language, but that the more complete use of language must probably be explained in terms of the trial-and-error association of random sounds with objects happening to be present at the moment. Every animal possessing a vocal apparatus of any sort tends to use it and to develop various forms of vocal expression. In lower animals this process is extremely limited, owing to the crudeness of the vocal apparatus itself, as well as to the absence of a complicated nervous system such as ours, which is capable of providing innumerable new associations. In the final analysis, then, the great mass of our speech must be thought of as growing out of the same trial-and-error activities that underlie other forms of social behavior.

Writing represents the final stage in the use of language. It apparently arose from primitive drawing, or "pictograph writing," as it is called. Pictures themselves are, of course, symbols, since they stand for some real object or occurrence. As the picture becomes more and more highly simplified and reduced in its outlines, we have true pictograph writing. When the forms have become entirely conventionalized so that they have no observable relation to any natural objects, we have modern writing.

The importance of language in making modern social life possible cannot be overestimated. Language makes communication possible in an extremely efficient form. In this connection it is interesting to observe that the relative importance of the written and the spoken language in a society is related to the stage of develop-

ment of instruments for using each. We have become accustomed to believe that the written word represents the highest expression of language, as well as the one most important for civilized life. There is some evidence that this situation may not continue to hold with the development of new means of spoken communication. Talking pictures and the radio, together with television, open the way for a society in which the spoken word may once again become the predominating and almost exclusive means of communication. Already courts of law are using phonograph and other direct recordings of speech instead of having the record taken down through shorthand and transcribed into written language.

Speech and Speech Defects. Human speech results from the combined functions of the larynx and the mouth and nasal passages. The larynx itself consists in the group of cartilage and muscle structures which we call the "Adam's apple." Across this section of the windpipe two strands of muscular tissue are stretched. These tissues are so controlled that they can be brought close together or moved apart. The closer they are together, the more vigorously they will vibrate, as a result of the passage of air through the windpipe.

Another group of muscles causes changes in the tension on these vibrating cords. These changes in tension result in differences in the rate of vibration. In addition, each set of vocal cords will have its own natural vibration characteristic. We thus see that the vocal cords may produce tones that are variable in the three fundamental qualities of tones; *viz.*, pitch, inten-

sity, and timbre. We also see that the larynx functions exclusively as a vibrating instrument. This means that the larynx produces nothing but tones. The resonance chambers in the nasal passages and in the mouth are responsible for the production of noises. Noises, as we shall later see, are sounds in which there is no repetition in the wave pattern.

Human speech is made up of vowels and consonants. From the preceding analysis we see that the vowels, which are tonal in nature, are produced by the larynx; whereas the consonants, which are essentially noises, will be produced by the other parts of the speech apparatus. The number of tonal patterns the larynx can produce is somewhat limited; hence, there is a small number of vowels in our speech. The number of consonants that may be produced is limited chiefly by the difficulty of acquiring patterns of muscular contraction of the tongue and cheeks. Because the muscular contractions that produce constant forms have to be learned, the development of consonants in the speech of the child comes later than the development of vowels. This explains the fact that "baby talk" is so largely made up of vowels and why the consonants are either left out or mispronounced.

Speech quality, like other personality traits, results from two factors, inherited structure and habit formation. Structure may determine the fundamental pleasantness or unpleasantness of the voice, together with its fundamental pitch. Thus, the higher pitched voice usually found in women results from these physical differences in structure. Speech defects are often the

results of defects in physical structure. A broken nose or other obstructions in the nasal passage will interfere with the resonance functions. The cleft palate and the condition of being tongue-tied are other examples of serious physical defects that affect speech. Fortunately, these conditions can usually be improved through proper surgical treatment.

Other speech defects may result from poor habit formation in connection with the voluntary control of the tongue and lips. Stuttering, stammering, lisping, speech mannerisms, and the like usually have their origin in bad habit formation. Where these conditions exist, special speech training is indicated. Since we are dealing here with habits, it is clear that the earlier such speech training can be had the better.

In order to study the kinds of sounds produced by the parts of the speech apparatus, various instruments have been devised. Most of these translate the sound waves into a vibrating pattern of light, which can be cast upon a screen. The phonelescope is such an instrument. By speaking into the mouthpiece of this instrument, the vowels and consonant sounds can be seen upon the screen in the form of their characteristic patterns. Further attention will be paid to the question of sound patterns in the chapters on sensation.

In addition to verbal and written language, the human being makes use of other forms of social stimulation. Characteristic facial and bodily expressions in connection with emotional responses come to act as purposive means of communication. Thus, one may curl his lip in a sneer as a means of expressing anger

or may assume the facial expression of disgust. The emotional expressions, together with various attitudes or general bodily postures, are really forms of gesture. They often develop unconsciously, however, and are frequently misinterpreted, especially when one is among strangers.

Thinking

The nature of the thought processes remains a mystery to most people. Psychologists have succeeded in analyzing these processes, however, and are in fair agreement as to their nature. It has been learned that in thinking we are carrying out in an abbreviated way the same types of action present in talking. Delicate instruments may be attached to the lips or to the skin over the larynx in such a way as to prove that these organs are active during thought processes. Parents sometimes wonder what their babies are thinking about. As a matter of fact, if the babies cannot talk, the probabilities are that they are not thinking at all. This may not be literally true in the sense that other more general muscular contractions or feeling experiences may act very much as thought processes. Certainly, however, organized and systematic thinking follows, rather than precedes, the development of speech. We used to say that talking is thinking out loud. It is more proper to say that thinking is talking to oneself. Here, again, a new understanding of methods for improving thinking becomes obvious when we know what thinking is. In order to improve our thinking we must improve our speech. We must increase our vocabulary, our range of

general information, and we must improve our fluency in expressing the things we know.

Several interesting examples may be quoted to demonstrate the truth of the idea that thought is implicit speech. The story is told of a superintendent of a deaf-and-dumb institute whose son, though normal, had learned to read the sign language. On occasion the father would return home deeply concerned over some problem relating to his work. He had the habit of pacing up and down his study with his hands behind his back. He was frequently amazed at having his son announce to him the subject matter of his thoughts. Analysis showed that the man, who was also skilled in the sign language, was unconsciously moving his fingers in keeping with his thoughts, and that the son was merely sitting by, noting the partly explicit movements of his hands.

Somewhat similar in nature was the scientific study carried out by Dr. Jacobson who found that if a football player is asked to imagine himself kicking a football, the instant of the imaginary kick could be determined by attaching a delicate galvanometer to his leg muscles. In other words, when the subject thought about the kicking, he actually contracted the muscles of his leg to a slight extent.

In a further experiment on this problem, Jacobson found that when normal subjects engaged in thought processes, electrical impulses relating to slight movements of their lips could be picked up. No such occurrence could be detected as arising from their fingers. When the same apparatus was attached to the lips and

fingers of deaf mutes, it was found that the lips gave forth no impulses, but that their finger tips gave off patterns similar to those given by the lips of normal subjects.

The Ouija Board. Further evidences that thought processes are related to actual physical behavior is provided by the automatograph. This instrument consists of a board the size of a book which is mounted on rollers so as to slide easily over a table surface. A pencil is inserted through the board so that as the board moves the pencil will leave a trace. In psychological experiments the subject is blindfolded and has his hands placed upon this board. If under these circumstances he listens to the experimenter who walks around the room talking, it will be found that the hands will push the board about so as to unconsciously follow the movements of the experimenter. In the same way subjects can frequently be found who will trace their thought processes on the board in the form of fragments of words or bits of pictures. The student may have guessed that this psychological phenomenon underlies an interesting bit of pseudo-psychology. The Ouija board is nothing more than the automatograph used for amusement or sometimes for serious efforts at fortunetelling. It is true that the Ouija board frequently returns remarkable answers to questions; and why should it not since one can scarcely be asked questions for which he will not have at least something in the way of an answer in terms of his own wishes or fears? Since the subject is concentrating, it is perfectly natural that the hands should unconsciously move in directions that will provide the answer of which he is thinking.

Thinking and dreaming are basically identical phenomena. In dreaming the thought processes are less closely regulated than they would be in ordinary thinking. This is because during sleep the number of inhibitory stimuli which might stand in the way of unusual expressions are reduced. The thought processes are set going by some minor stimulus and then left to wander unguided. This again explains why dreams sometimes come true. We dream about the things we want. We also strive in waking life to get the things we want. What could be more natural than that the two processes should sometimes coincide?

Reasoning

Reasoning involves the direction of our thinking toward the solution of a specific problem. In reasoning out a problem we are quite literally manipulating, in a trial-and-error way, the elements of the situation with which we are dealing. Sometimes reasoning processes may not be carried on entirely in the form of thoughts. In puzzle solving there is a combination of "mental" juggling of the parts of the puzzle with a certain amount of actual handling of them with our fingers. In trying to reason out the best line of attack in some business problem, we behave in much the same way. All forms of thinking then relate to the manipulation of parts of our environment. This manipulation is, as we have said, either partly or entirely in the form of symbols. In every case the final goal can be shown to be that of a better adjustment to the environment.

Fig. 31.—Studying the trial-and-error nature of reasoning.

(Facing page 246)

Creative Thinking. Thinking has one very great advantage over the actual trial-and-error manipulation of observations in that mental elements can be put together in combinations that would be impossible in actuality. Thus we can imagine the monster called the griffin, which is usually described as a cross between an eagle and a lion, having the head and wings of the eagle with the body of the lion. Various other modifications are sometimes added. Our point is that no such animal ever existed in real life, and yet we are able to deal with it and to think about it in our imaginations. It is because thinking permits these endless new combinations that it is so important for human beings. It also explains the significance of creative thinking in inventions both of machinery and of new ideas and theories. Inventions are the result of the combination of old elements in new ways. The griffin was an invention, of course, but one which, like some perpetual-motion inventions, was not of much value.

Creative thinking may be of two types, controlled and uncontrolled. In controlled thinking, elements are combined and new parts added, although an effort is constantly made to keep the pattern of such a nature that it does not conflict with reality. In uncontrolled thinking the new combinations are developed without regard as to whether or not they could ever be carried out in real life. Much of our ordinary daydreaming is of this second variety, whereas the creative thinking of inventors, scientists, and philosophers represents the former type. It is interesting that this slight difference, as to its relationship to reality, marks the difference

between thought processes that represent the highest achievement of the human mind and those that are mere "wool gathering" and a waste of time.

The effectiveness of creative thinking will depend in large measure upon the breadth of one's cultural background. The cultural background provides the raw materials or elements out of which the new combinations are to be built. Little originality can be expected where the cultural background is limited. Here again we find an argument in favor of broad cultural training in college. Every student should aim to achieve such a general background in addition to the specialized studies in his own chosen field.

Development and Use of Symbols

The stages in the development of symbolic processes may be summarized according to the following outline:

A. Actual (overt) behavior and objects

B. Symbolic behavior and objects

1. Gesture—pictures
2. Language—writing (these are formalized gestures and pictures)
    a. Thinking (implicit language)

By way of review the outline may be interpreted as follows: Our contacts with the surrounding world consist originally of complete physical actions carried out in reference to original and complete objects in our environment. In other words, we actually pick up a stick and hit an enemy. This is called overt, or easily observed, behavior. The first stage of symbolism comes

with gestures that are incomplete bits of action. Thus, shaking the fist is an incomplete part of the total act of striking a person. In the same way, pictures are fragments of original objects. Pictures in turn may have developed through another intermediate step, *viz.*, small models of the original objects such as dolls, toy automobiles, and the like.

After a time gestures and pictures become formalized, *i.e.*, a given bodily movement or facial expression may come to have a meaning assigned to it which could not be guessed if one had not been trained to recognize the meaning. In the same way sounds come to have their own formal meanings. Thus "Meow" and "Moo" are gesture sounds relating to the original behavior situation, whereas the words "cat" and "cow" are purely formal sounds referring to the same thing. In a like manner written words are purely formalized pictures developed usually out of the old pictograph writing. When the muscular movements that produce spoken language are reduced to an absolute minimum, no audible sounds are produced at all, and yet it can be shown by means of an action-current apparatus that the larynx and other parts of the speaking mechanism are carrying on invisible movements of the same pattern that would be present if spoken words were being produced. In the case of thinking reactions the movements have been reduced to a point where they are no longer useful as a means of communication from one person to another. They operate, in fact, merely as a means of self-stimulation. It is this ability to carry out the equivalents of complete actions, in short, to get the

benefits of trial-and-error learning without actually going through the movements, that constitutes the great advantage of reasoning. It is because man is able to do this that he not only can solve many more problems per hour than any other animal, but can also solve problems that are so complicated or long-enduring that it would be impossible or impractical to do them in their original form. Through this long and devious route, therefore, man has come to be the "thinking animal" and thereby to occupy his present dominant position in the world.

Semantics. In recent years scholars have become increasingly aware of the importance of symbolic actions in making human mental life possible. They have begun to understand, moreover, a danger that lurks in the use of symbols. This danger is that psychologically it is as easy for a symbol to stand for one thing as for another. Now, if Jones uses a given symbol to mean one thing and Smith uses the same symbol word for another object and Brown uses it for still a third object, it is obvious that only confusion can result from their discussions. An illustration of this may be found in the word "wench." To most older Americans the word refers to a woman of either unsavory reputation or unpleasant personal traits. In the "slanguage" of the younger generation, however, the term may refer, with no particular intent at slander, to any young woman. Indeed, this is getting back to the original meaning of the word when "wench" referred to any girl or, particularly, any servant girl. Now certainly if a young man tells his father that he is going out with a wench the

father may have a reaction quite different from that intended by the young man. It becomes clear, then, that the important thing about symbols is not what any symbol stands for as such, but rather that everybody shall be agreed as to what it stands for. Reduced to its simplest terms, then, the psychology of meaning becomes a matter of agreement as to the original object whose place the word takes, its "concrete referent," as the semantists would say.

The classical and somewhat technical treatise on the matter of symbolism is the work of Ogden and Richards bearing the ingenious title, *The Meaning of Meaning.* Chase presents a popular study of semantics in his book, *The Tyranny of Words*, of which the first chapter or two are especially useful for the beginning student. Thurman Arnold has studied the way in which symbols are used and abused in connection with government and the economics of capitalism. One of the most interesting and understandable works on semantics is Hayakawa's little book, *Language in Action*, which bears such provocative chapter titles as "How We Know What We Know," "Rats and Men," and "The Little Man Who Wasn't There."

Students of semantics are much concerned with the more or less conscious abuse of symbols in the propaganda activities of politicians, businessmen, and sometimes of just plain Mr. Average Man. The word "propaganda" originally meant something pretty close to our word teach, but in recent years it has come to have an unsavory connotation in that it tends to refer to a purposeful confusion between symbol words and

the objects for which they stand. Once the public is used to associating certain symbols with good or useful objects, institutions, or actions, it may then be possible to use the symbol to set off responses in cases where the real objects are neither good nor useful. The terms patriot and American have good and proper meanings, but if one is urged to be a patriot by attacking another man merely because he differs in his views on labor, religion, or politics, then we have an abuse of symbolism. Some of the ways in which symbols can be abused have been listed by the Institute for Propaganda Analysis. The following are adopted from their list:

Propaganda Techniques

1. Name Calling. To call a man a snake or a dog is, of course, a way of attributing to him some of the characteristics exhibited by the animals that bear these names. This device works because of the force of habit, so that while in many cases we would not really attribute these traits to a man, we nevertheless allow him to suffer a lowered estimation just because we do not think the thing through and so accept the implied association more or less at face value.

2. Generalities. Some symbol words, such as goodness, nobility, meanness, and viciousness, may refer to a large group of specific acts. When generalizing, one can apply such a term to a person, thus attaching to him the general traits without at the same time in any way analyzing whether these traits constitute his most important characteristics.

3. Testimonials. Testimonials work somewhat in the way of generalities. If a given person has come to be associated with a generality such as being a good man or a wonderful athlete, then this specific goodness of his will carry a general idea of worth so that, if a good football player states that he drives only a certain brand of car, we tend to approve of the car, forgetting that his skill and judgment in football may be no indication at all of a similar skill in the field of automobile engineering. In the same way the judgment of society women regarding the merits of various cigarettes is frequently employed. The fact that a woman is a charming socialite certainly constitutes no proof that she is an expert judge of tobaccos.

4. Card Stacking. Card stacking, the presentation of biased or incomplete facts, leads to distorted thinking. We remember in our introductory discussion of the scientific method that stress was laid upon the importance of making our observations as accurate, objective, and complete as possible. Law courts recognize the danger of card stacking when they require that a person giving testimony swear to tell "the truth, the whole truth, and nothing but the truth." Unfortunately, emotional bias and even habitual ways of thinking frequently lead us to "stacking the cards" unconsciously with results that are just damaging as though we carefully planned to mislead another.

5. The Band Wagon. Getting on the band wagon is an example of a propaganda device that is really based upon a particular kind of the fallacy of generalization. The fundamental notion of democracy as ruled by the

majority has become so ingrained in us that we frequently make uncritical inferences from it. Among these inferences is the idea that the majority is always right. Now just the fact that the majority rules in a democracy does not necessarily imply that the majority is always right. Indeed, critical thinkers are quite willing to agree that the majority is frequently wrong. Democracy is important precisely because it permits people to go ahead and make mistakes and thereby discover their errors and improve their lot, whereas under a dictatorship people are not allowed to make their own decisions and so may never learn of better ways of living. In the solution of a given personal problem, then, the fact that everyone is acting in a given way should be far from satisfactory evidence that that is the way in which we should act.

In trying to resist propaganda, which in these days is heaped upon us in increasing quantity, it may be helpful to consider the following points when passing judgment on any matter that may have elements of propaganda back of it.

1. Your own prejudices may be as dangerous as the next man's. Beware of them.

2. Do not allow yourself to be stampeded; take time to use your brain.

3. Reducing everything to a twofold classification (good—bad, either/or) is primitive logic. Modern problems usually require the consideration of many aspects.

4. Absolute words are dangerous

5. Be sure all the evidence is available.

Basic English

A system of basic English has been devised by C. K. Ogden as a contribution toward curbing some of the hazards of misunderstanding and abuse that have grown up around the use of symbols. Students of semantics all agree that much of our trouble comes from the fact that we use so many symbols that few of us can be certain as to just what each word stands for. Odgen has attempted to reduce these hazards by setting up a basic vocabulary made up of only 850 words. He believes that it is possible to carry on all general communications with this small vocabulary. It is hoped that even the average man can keep in mind exactly what each of these words stands for so that he will be immediately aware whenever any of the tricks of words which we have discussed under the heading of "Propaganda" are used. Where language is used for scientific or other specialized purposes it is suggested that an additional vocabulary of about 150 words be added to the basic vocabulary for each specialized study. As basic English comes into wider and wider use it will also serve a valuable purpose in making the English language more practical as a universal tongue, since foreigners can easily learn 850 words and will then be able to communicate either with English-speaking people or other foreigners who in turn know basic English. It is possible that we have here the beginnings of a new universal language that will be much more practical and accurate than was Latin, which served in a similar capacity during the Middle Ages. Already the New Testament has been translated

into basic English as have selected chapters in various books, particularly those dealing with the problems of semantics.

Thorndike's Junior Dictionary. The eminent American psychologist, Thorndike, has made a contribution toward the controlled use of the symbols of language through his studies of word frequencies. This study began with a count of the frequency with which various words appeared in a sample of 10 million running words of nonspecialized text. On the basis of this word count Thorndike found which words bore the heaviest loads in social communication. Generally speaking, the reduction of communication to these frequently used words will make for simplicity and understandability although perhaps not for richness of literary style. Following up this scientific study, Thorndike has issued the *Century Junior Dictionary* made up of the 20,000 words most commonly used in our language, together with a few thousand carefully selected words of less frequent usage. Each of these words is defined in language that is itself confined to words of high frequency and therefore of greater intelligibility to children. In addition the actual frequency of usage of each word is indicated. A few illustrations taken at random will serve to show how the definitions have been put into youthful yet clear language and also how the frequency of use may vary.

Air is defined as follows: (1) Birds fly in the air. (2) It is good to air your clothes every night. (3) Make known. Don't air your troubles too often. (4) Melody; tune. In music the air is the leading part. (5) Way; look; manner.

He had the air of a child who was afraid. (6) Airs means affected or showy manners. (7) Light wind; breeze. Air is among the first thousand words in the language as to frequency.

Atrocious is defined as: very wicked or cruel; very savage or brutal; and s in the fourteen thousandth frequency group. In speaking of the psychology of word definition Thorndike points out that definitions in terms of historical development of grammatical catagories are relatively useless to children (and the author might add, probably also to the average layman). The principles of arrangement as used by Thorndike are "literal uses before figurative, general uses before special, common uses before rare, and easily understandable uses before difficult." The samples cited above show how these principles are applied.

The discussion relative to the use of words may be summarized by the statement that words have made us human and have made possible the tremendous power and control over the world which we possess. At the same time the use of words has become so complicated as to constitute a genuine hazard. They might almost be thought of as one form of a Frankenstein—a Frankenstein which fortunately can be tamed through the principles advanced in the critical studies we have mentioned.

SUGGESTED READINGS

ARNOLD, T.: *The Folklore of Capitalism.*
BRITT, S. H.: *Social Psychology of Modern Life*, Chap. 8.
CHASE, S.: *The Tyranny of Words.*
CRAFTS *et al.*: *Recent Experiments in Psychology*, Chaps. 25, 26.

CRANE, G. W.: *Psychology Applied.*
DEWEY, J.. *How We Think.*
HAYAKAWA, S. I.: *Language in Action.*
HERRICK, C. J.: *The Thinking Machine.*
KLINEBERG, O.: *Social Psychology*, Chap. 3.
OGDEN and RICHARDS: *The Meaning of Meaning.*
WARREN and CARMICHAEL: *Elements of Human Psychology*, Chap. 12.

Chapter 10

THE NATURE AND MEASUREMENT OF INTELLIGENCE

Two Modes of Adjustment

NATURE may be thought of as having settled upon two basic procedures in meeting the struggle for existence. In animals other than man success is attained through specialization of structure. It has been said that man builds tools, whereas animals grow them. The webbed feet of aquatic animals, the protective shells of snails and turtles, the claws and teeth of tigers, and the excellent running equipment of the deer are all examples of structure that give various animals a distinct advantage in the struggle for existence. We have already seen that much of the so-called "instinctive" behavior of animals can be explained as resulting from the fact that such specialized structures cannot function well in other than narrowly limited ways. Consequently, animals in their trial-and-error activities will inevitably come to act in these stereotyped fashions.

Specialized structures and the resulting stereotyped behavior may result in very effective adjustment to a particular type of environment. Should the environment change, however, or the animal be forced into a

new locality, it may find itself totally unsuited to its new surroundings. Since it cannot change its inherited structures, such an animal will lose out in the struggle for existence and may even become extinct.

In man, nature has seemingly experimented with a different means of adjustment. A wag has said that man has specialized in but one thing: nonspecialization. In fact, although man has several unique structures, he has few that seem particularly adapted to one special environment. Consideration of man's physical structures reveals that he has no specialized organs for offense, defense, or flight. His fists and unfanged teeth are puny weapons of attack compared to claws and fangs of members of the cat family or the hoofs and horns of the cow or moose. He is as wanting in a tough protective skin, fur, or shell to aid in his defense as he is in fleet limbs or swift wings for escape by flight.

Man's success has come from the very fact that he is not specialized in his structure. Instead he is supplied with organs that are amazingly flexible and modifiable in their use. Consider the almost limitless uses to which his hands can be put and the great range and flexibility of his vocal apparatus!

Exercise: List in one column 20 specialized structures found in animals. Opposite each of these indicate the tool or other artificial device by which man achieves equal or greater results.

Man's nonspecialization in structure would, of course, be useless if he were not provided with a nervous system of sufficient power and modifiability to permit him to learn to use his structures in a great variety of ways.

The great size and fine quality of man's brain are perhaps his one point of specialization, although even here, as has been suggested, the specialization is of a unique sort, *viz.*, specialization for change.

Man is man and not merely another animal precisely because he possesses these twin characteristics of non-specialization and modifiability.

Intelligence

Definition. The preceding discussion should prepare the student to grasp the significance of the definition of intelligence as the capacity to adapt to one's environment. Adaptation in the human involves changes in habits as the result of experience, in short, the acquisition of new modes of behavior. It is for this reason that intelligence is often more precisely defined as the "capacity to learn."

Human beings need to be able to learn many different kinds of things. They must learn to manipulate the tools and other mechanical objects that surround them. This ability is called "mechanical intelligence." They must learn to carry out certain special kinds of behavior when in the presence of other humans. This ability is called "social intelligence." Finally, they must learn to manipulate the complex set of symbols that make up such functions as language and mathematics. The ability to deal with these and related symbolic functions is called "abstract intelligence."

Two Views of Intelligence. One group of psychologists, led by Thorndike of Columbia University, believes that each of these three and perhaps other special abilities

constitute independent expressions of intelligence. In short, they believe that instead of talking of intelligence we should speak of intelligences. One's "general intelligence" would for Thorndike be merely a composite picture of all the various abilities possessed by a person.

The English psychologist, Spearman, and his followers believe, on the other hand, that intelligence should be viewed as unitary underlying power or ability level. This he calls the *G* factor, referring to "general" intelligence. He states that there may be various *S* or special capacities through which the *G* may express itself. The important point of Spearman's view is that the *G* factor will determine the general level of all of the reactions of the individual. It is the *G* factor which he would seek to measure by means of intelligence tests.

Fortunately the successful use of intelligence testing does not depend upon a solution of this controversy. The fact is that there are wide individual differences in the ability to learn to perform various functions. It is to the measurement of these various abilities that intelligence testing is devoted.

Characteristics of Intelligence. Intelligence in humans is best thought of as the functioning of various nonspecialized structures. Obviously, these structures are innate and their characteristics are determined according to the laws of heredity. Intelligence, therefore, is innate. In light of this fact we understand that it cannot be changed any more than an inherited tendency to be tall or short can be changed. *The use to which intelligence is put depends on training, but the capacity to learn is*

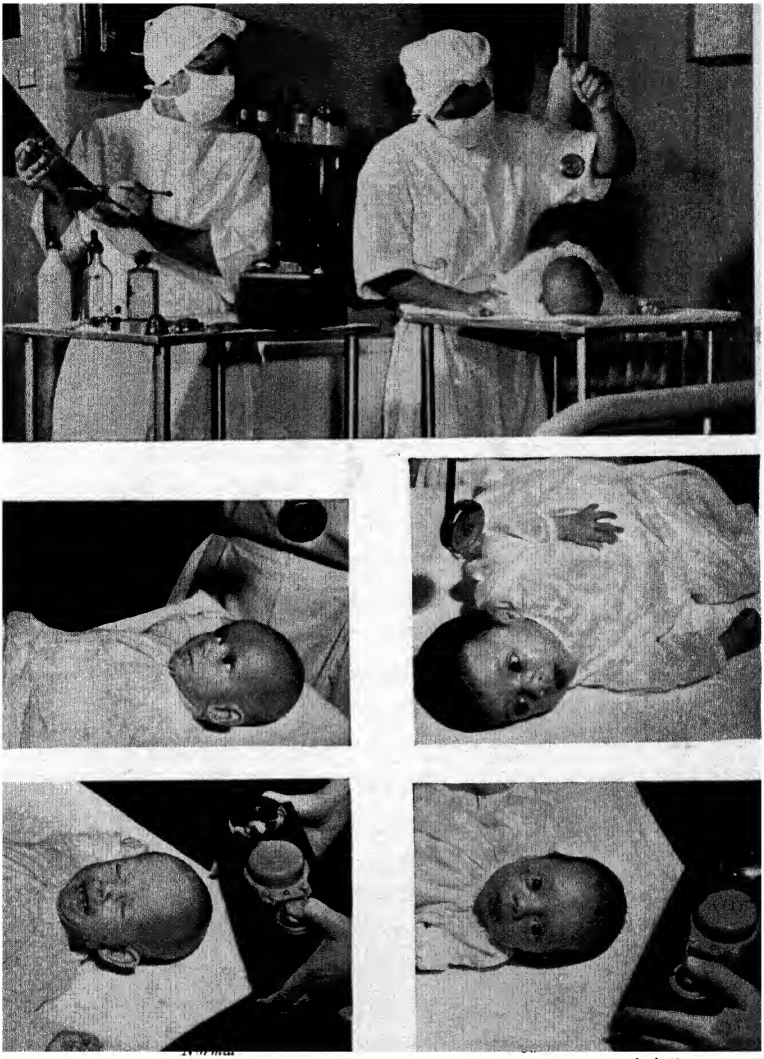

Fig. 32.—*Responses of normal and subnormal babies to a new series of tests devised at Northwestern University.* (*Courtesy of Dr. Gilliland and Life Magazine.*)

(*Facing page 262.*)

innate. The observation that intelligence is inherited in the same way and to the same extent that other physical traits are has been fully verified by many scientists.

Intelligence seems to mature more rapidly than do most gross physical traits. It is usually said to be mature by the time the person is sixteen although some psychologists believe that it matures as early as fourteen. Students sometimes find it difficult to understand that one is as intelligent as he will ever be by the time he is 16. It is important to remember that intelligence and knowledge are two separate things. No one is surprised at being told that he is as tall at nineteen or twenty as he will ever be, or that his general level of potential physical strength will be as great at early maturity as it will ever be. Here, as with intelligence, we may or may not exercise this ability. Knowledge results from a proper use of intelligence; but the *ability* to acquire knowledge may be present whether or not we ever use it.

Individual Difference. Intelligence exhibits the fact of individual differences as do physical traits. In other words, people range in intelligence all the way from extremely low capacity, as seen in the feebleminded, to very great ability, as shown in the genius. These differences are hereditary. Just as short parents tend to have short children, so dull or bright parents tend to have children who resemble them in mental capacity. Every student should familiarize himself with the work of the great English scientist, Sir Francis Galton, and his followers in this field.

Measuring Intelligence

Tests measure what intelligence has accomplished. It would be convenient if we could measure intelligence directly the way we measure height and weight. Several attempts have been made to do this. These have usually centered around the hope that intelligence could be measured in terms of the speed of nerve action. Attempts have thus been made to correlate intelligence with simple reaction time and with reflex reaction time. All such attempts have resulted in failure, indicating that intelligence is too complicated a function to be measured in terms of any such special functions. These facts need not surprise us when we recall that no coach would try to measure the running ability of an athlete by measuring the length of his legs. Likewise, he would not try to determine relative abilities of wrestlers by the size of their muscles.

Intelligence tests proceed by the same common-sense method that all other measurements of function use. In order to measure an athlete's running ability we time him in a race. To measure strength we note the maximum size of weights that can be lifted. In the same way we measure intelligence by measuring the success that an individual shows in doing the things for which we use intelligence. Intelligence tests usually refer to success in handling the abstractions involved in language, arithmetic, and geometric forms.

The observing student may ask at this point how we can measure intelligence, which is a native or inborn ability, by measuring the ability to use symbols, which

is undoubtedly learned. The answer is that a capacity can best be measured in terms of what it has accomplished. A certain precaution needs to be noted, however, at this point. We must be sure that all the individuals have had an equal chance to master the thing we are measuring. Think again of the athlete. Even though a Paavo Nurmi or a Jesse Owens be born with the capacity to run, it is clear that they would never become champions without training. It is also clear that, if some other person of less native ability were carefully trained and the potential champion were not, the former would very likely win. It is only when each contestant has had the advantages of *training* that a race can really show which is the greater runner.

In intelligence testing exactly these same precautions are taken. An intelligence test will be largely only on those materials which every subject will have had a *chance* to learn. In some cases they will require the subjects to do something which none of them has previously done. In this case the actual learning process is measured. For the most part, however, tests are based on the basic functions learned in grammar schools. Since throughout the country everyone is required to go through at least the eighth grade, the tests measure fairly. It should be noted carefully that if a given person, because of foreign birth or lack of educational opportunity, has not had a chance to learn these functions, then the results of the average intelligence test would be of no value in determining his native intelligence. Failure to recognize this vital point has led to some extrava-

gant and false conclusions as to the relative intelligence of various races or of certain special groups.

Alfred Binet. A French psychologist, Binet, is credited with evolving the first successful scale of intelligence tests. He succeeded where others failed in the first place

TABLE 11

Items from the 1908 Binet Scale

AGE THREE YEARS

1. Points to nose, eyes, mouth
2. Repeats sentences of six syllables
3. Repeats two digits
4. Enumerates objects in a picture
5. Gives family name

AGE SIX YEARS

1. Knows right and left as shown by indicating right hand and left ear
2. Repeats sentence of sixteen syllables
3. Chooses the prettier in each of three pairs of faces
4. Defines familiar objects in terms of use
5. Executes a triple order
6. Knows age
7. Knows morning and afternoon

AGE SEVEN YEARS

1. Tells what is missing in unfinished pictures
2. Knows number of fingers on each hand and on both hands without counting them
3. Copies "The little Paul" with pen and ink
4. Copies a diamond, using pen and ink
5. Repeats five digits
6. Describes pictures as scenes
7. Counts 13 pennies
8. Knows names of four common coins

because he recognized that a test should be a sampling of the various things that a person might fairly be expected to do. Earlier attempts had failed because they tried to measure intelligence in terms of one thing, such as memory. Note in Table 11 the variety of functions which children of various ages are asked to perform.

Mental Age Concept. A second feature of Binet's work was his recognition that intelligence matures and that

mental age increases as the chronological age advances. As the children tested grow older, it is necessary to devise items of appropriate difficulty as shown in Table 11. A given mental age (M.A.) refers to the average mental development of children of a given chronological age, *i.e.*, twelve-year-old children will have an average mental age of twelve.

This leads to the third feature of mental testing that was contributed by Binet. Tests for the various ages and the standards for the various mental ages were not invented or fixed in an a priori manner. Rather they resulted from a long series of experiments in which he determined what material each age could master and what the average achievement (mental age) of each chronological age was.

The I.Q. Although the average mental age of ten-year-old children is ten, it is clear that a certain proportion of the individual ten-year-olds may be either more or less than ten-year-old "mentally," just as they may be tall or short "for their age." Now, no one needs a psychologist to show him that, if a child of ten could do all the things the average twelve-year-old should do, he is "bright" or advanced "for his age"! Similarly if he failed in everything above the eight-year-old level, it would be clear that the child is dull.

It is just this situation of being advanced or retarded "for one's age" that the intelligence quotient or I.Q. indicates. Otis has pointed out that the I.Q. is really an index of brightness. It tells how far along the child is mentally in relation to his actual age in years. Stated scientifically we say that the I.Q. is the ratio between

the mental and the chronological age. It is found by dividing the mental age (as determined by tests) by the chronological age: $\frac{\text{M.A.}}{\text{C.A.}} = \text{I.Q.}$

Using our example of the ten-year-old boy who passed all the twelve-year-old tests, we apply our formula and find: $\frac{12\ (\text{M.A.})}{10\ (\text{C.A.})} = 1.20$. In ordinary practice we ignore the decimal point and call the I.Q., 120. The dull boy who passed only the eight-year-old tests would by the same formula have an I.Q. of 80 $\left(\frac{8}{10} = .80\right)$. The average ten-year-old will just pass the ten-year-old test so his I.Q. is 100 $\left(\frac{10}{10} = 1.00\right)$. Thus we see that an I.Q. above 100 indicates acceleration, and one below 100 indicates retardation in mental development.

It has been established that mental age and chronological age advance at the same relative speed. For this reason the I.Q. of a given person never changes. At five years of age, our bright boy would have passed the six-year-old tests $\left(\frac{6}{5} = 1.20\right)$. This accounts for the apparently surprising fact that one is as bright at five years of age as he will be at thirty or fifty. The constancy of the I.Q. is responsible for its usefulness. It provides a common scale of reference by which persons of all ages may be classified as to degree of brightness. In many large schools it is now the practice to group children into "ability" groups instead of "age" groups,

as used to be the common practice. For the academic work of the classroom, it is more important that each child be matched with others of similar ability in academic work than it is that they be of the same chronological age. In groups where the individuals differ widely in mental ability there is always the double tendency for the more able pupils to become lazy through not having enough competition, at the same time that the less able ones are developing an attitude of defeat through never being able to excel regardless of how hard they try. Teachers in these cases are all too likely to find themselves spending their time trying to help the poorer students, whereas the abler ones, who would really profit most by special attention, are likely to be left to their own resources since they seem to "get along all right" anyhow. Problems of a similar nature in other fields will be discussed in a later section.

Types of Tests. Following the original work of Binet, many types of intelligence tests have been devised to meet special needs. Following is a classification of the more important types.

1. Translations of the Binet test. The most widely used American translation is the Stanford (University) Revision by Dr. Lewis M. Terman.

2. Individual versus group tests. The Binet test and its translations are administered individually. Most of the batteries of tests for young children are also individual tests. It is frequently possible and economically necessary to test fairly large groups of subjects together. This is done by means of group tests. The army tests,

the Otis tests, and those devised by the American Council on Education (Thurstone) are examples of these.

3. Language versus nonlanguage, or performance, tests. Recalling that a test presupposes that all subjects shall have familiarity with the materials used, it will be clear that there are important groups of persons unable to use our language, but whose intelligence it is important to ascertain. This is done by means of performance tests in which the use of language is either eliminated or reduced to a minimum. The Army Beta Test for adults and the various batteries of form board tests for children illustrate this method of testing.

4. Speed versus power tests. Most intelligence tests are speed tests. This is because of the necessity of conducting large-scale testing programs according to a time schedule. When properly standardized, the portion of a given task correctly completed within a fixed time limit will give as good an index of ability as will the portion correctly completed in an unlimited time. Because intelligence tests are widely administered in schools, most of them are so designed as to be administered in less than 1 hour. Such a time limitation not only fits into the work periods of most schools but avoids the excessive fatigue that might result from longer periods of work. Tests for young children are generally planned for still shorter periods of time.

A few tests, notably the Binet individual and the C.A.V.D. group test, operate on the "power basis" in which no limitation is placed on the amount of time that may be taken in the solution of the problems. Test

subjects often protest that they could have bettered their score if they had "only had a little more time." Doubtless, many of them could have improved their absolute score, but of course their classmates would have been improving theirs also, so that, as many psychological studies have proved, the relative score would be exactly the same on a power basis as it is on a speed basis.

Applications of Intelligence Testing

Distribution of Intelligence. We have already seen that intelligence is distributed according to the biological curve. It is the usual practice to divide individuals into three classes according to their intelligence: feebleminded (I.Q. below 70), normal (I.Q. 70 to 130), and gifted (I.Q. above 130). Within each of these groups are certain more or less arbitrary subgroupings. One such classification, with the proportion of the general population in each, follows.

TABLE 12

CLASSIFICATION	I.Q. RANGE	PERCENTAGE OF POPULATION
Feebleminded	Below 70	1
Borderline	70 to 79	5
Retarded	80 to 89	15
Normal	90 to 109	58
Accelerated	110 to 119	15
Superior	120 to 129	5
Gifted or genius	Over 130	1

Feeblemindedness. Three degrees of feeblemindedness are usually distinguished. (1) Morons—I.Q. 50 to 70. Mental age eight to eleven. Unable to care for themselves and earn a living in direct competition with normal people. Can usually complete first two to four

grades of school. (2) Imbeciles—I.Q. 20 to 50. Mental age three to eight. Cannot learn to read or do arithmetic. Small vocabulary, can do simple motor tasks if carefully supervised. (3) Idiots—I.Q. below 20. Mental age three or less. Though often of normal adult size these individuals have the mental development of babies. Usually unable to learn to talk and frequently unable to learn to walk, dress, feed themselves, or control their physiological functions.

The general sociological basis for the classification of feeblemindedness is that such persons require special guidance for their own welfare and to protect others from their lack of judgment. Such care can usually best be provided in state institutions. Here they can be taught to be partially self-supporting and are often happier at their simple tasks than they would be if confronted with the maladjustments they would face in outside life.

There is no evidence of any inborn tendency toward criminalism in connection with feeblemindedness. It does happen, however, that these persons, because of lack of judgment of moral values, or because of inability to compete successfully for a living on an even footing, may be driven into such antisocial forms of conduct as robbery and prostitution. Lack of social responsibility coupled with mental incompetence of another type is illustrated by the following story related by Mr. Gosney.[1]

A case illustrating this point, even though extreme, is presented by a woman with manic-depressive insanity committed to one

[1] From GOSNEY, E. S., "Eugenic Sterilization," *Scientific American.*

of the psychopathic hospitals. Her mother and sister had died insane, her brother had committed suicide while presumably insane, her husband was a sickly carpenter. They already had seven children. The Medical Superintendent told her she would probably be in and out of the hospital the rest of her life and suggested that she be sterilized since she could not take care of the children she already had; since any future pregnancy would probably precipitate another breakdown. She said she would talk it over with her husband. Later she advised the Superintendent that they had agreed that she would not be sterilized. "You know," she said, "we already have seven children and we are getting half-orphan aid from the state for them." (In California this is $10.00 per month per child.) "We have always figured that when we had two more children we would get enough for them so my husband could stop work and we could live on the income, so it would be too soon for me to be sterilized now."

In times of economic stress, such as the last depression, large numbers of very able people are forced to accept relief. At the same time a definite relationship has been shown to exist between level of intelligence and degree of dependence. In 1934 the 19 states averaging lowest in intelligence had 15.6 per cent of their population on relief, whereas the average of all the rest of the states was only 11.2 per cent.

Lack of social responsibility and the dysgenic factors operating among the less intelligent parts of our population are shown by the fact that in 1934 the birth rate of families on relief was 60 per cent higher than those not on relief. Students of eugenics point to these facts to show that society will continue to "die out at the top," unless action is taken as it has been by California and certain other states to control the reproduction of the inferior.

Since feeblemindedness is inherited, little can be done for the unfortunate individuals in any case. It is for this reason that the central problem of feeblemindedness relates to their effect on the fate of society as a whole.

Genius. Types of gifted persons have not been classified as carefully as have the degrees of mental deficiency. Perhaps this situation typifies the whole unfortunate trend of ignoring those very gifted persons who are really capable of rendering distinguished service to society whereas pity and dollars are squandered on cases where neither can help. The term "genius" is usually reserved for persons with an I.Q. of 140 or greater.

Characteristic of the erroneous ideas regarding genius is the one that genius is likely to be unbalanced or erratic and that the mentally superior person is more than normally weak physically. Both these superstitions are grossly wrong. In California, Professor Terman is carrying on a great study to determine more about the real nature of gifted persons. He has picked one thousand genius children at random from California schools, has given them a complete set of tests and measurements, and proposes to carry the study of their abilities and achievements clear through their lives. The results of the *Genetic Studies of Genius*, as he calls them, already fill three large volumes.

Results already prove conclusively that, instead of being spindly legged, underweight children with defective eyesight, gifted children actually are above average in weight and height, have better eyesight, and in general are superior in physical as well as mental traits.

The related idea that gifted children are apt to be unsocial bookworms has also been exploded. These children do, of course, read more than others because of the greater ability to comprehend, but they also have been shown to be leaders on the playground and in other phases of their social life.

Many studies showing the remarkable achievement of individual genius children have been made. One such study reported by Hollingworth tells of a child with an I.Q. of 187.

> In addition to his regular school work the child has covered the following special work in language and mathematics, either with a tutor or with his mother: Geometry, algebra, as far as equations; Latin, partial knowledge of the four declensions (he has been taught by the direct, informal method, and reads easy Latin); Greek—worked out the alphabet himself from an astronomical chart, between the ages of five and six years; French, equal to about two years in the ordinary school; German, ordinary conversation; Spanish, attended class with his mother—reads and understands; Portuguese, asked his mother to take this language at the Columbia summer school because he could not be registered himself; Hebrew, a beginner; Anglo-Saxon, a beginning. In astronomy he has worked out all the constellations from MacCready and displays a very great interest in this subject. One evening this winter he noticed a new planet near the Twins. He said it was Saturn, but his mother thought it was Mars. E . . . went home, worked the position out from the chart, and found it to be Saturn. He has a great interest in nature, wherever found, and is already able to use Apgar intelligently. His writing is not equal to his other accomplishments. He is very slow at it and for this reason dictates most of his "home work" to a stenographer. History is his chief and absorbing interest among school subjects.

Not all genius children express their capacities in such socially acceptable ways. The writer once studied

the case of a gifted child who also had a high degree of mechanical aptitude. Since his parents had failed to realize his abilities and to direct them into useful channels, this little lad of nine had set himself a challenging problem. It was to see if there were any automobile locks made which he could not open. To date there had not been! This wasted genius had expended itself in stealing and disposing of, without aid or detection, some thirty-odd automobiles. When finally apprehended and placed in a reform school, he came under the direction of the printing teacher. Here the same capacity turned into socially acceptable channels, enabled the boy in 3 or 4 weeks to memorize and learn to assemble all the parts of that most complicated machine, the linotype. At the same time he read three or four adult-level books per week!

Genius is unusual capacity; it is up to society to see that the capacity is properly directed.

Intelligence and Occupation

One of the most important applications of the measurement of intelligence is that of aiding in the selection of the job best suited to our several levels of ability. Studies made during and since the First World War have shown that there is a definite relation between intelligence and occupational grouping. This means that most occupations are best carried on by persons of fairly narrow range of intelligence. It has never occurred to some persons, even employment officers, that one may have too much as well as too little intelligence for a given job; yet Laird quotes figures showing (Table 13)

that a larger proportion of people of high intelligence left their clerical jobs than did those of low intelligence. Those of average intelligence seemed just to fit this work so that far fewer of these people left.

TABLE 13

Clerical Workers—Percentage Leaving Job in Less Than 2½ Years

(From Laird)

61% left	33% left	83%
Low intelligence	Average intelligence	High intelligence

The average intelligence level for various occupations are shown in Table 14. All such surveys have shown that

TABLE 14

Suggested I.Q.'s for Various Occupations

(From Feingold, *Journal of Applied Psychology*)

OCCUPATION	I.Q.
1. Teacher, engineer, lawyer, journalist, clergyman, accountant	126
2. Physician, novelist, grade teacher, banker, chemist	122
3. Draftsman, secretary, dentist	116
4. Stenographer, bookkeeper, nurse, clerk, gym or music teacher	110
5. Musician, photographer, electrician, druggist	103
6. Policeman, toolmaker, plumber, dressmaker, machinist, vaudeville actor	95
7. Carpenter, farmer, hairdresser	90
8. Sailor, structural steelworker	84

professional lines of work command the highest intelligence, skilled and technical trades the middle ranges, and unskilled labor the lowest.

The importance of determining the intelligence level of students and developing an interest in them for occupations appropriate to their ability is shown by a recent study of high-school students in which 45 per cent

chose careers above their level of ability whereas only 10 per cent chose ones below their ability. The former are to a large extent foredoomed to failure, whereas the latter are wasting their talents. The important thing is that less than one-half the students chose occupations suited to their intelligence. Table 14 shows the I.Q.'s needed for success in occupations of varying degrees of difficulty.

The relation of general intelligence to vocational success, as shown by actual studies in industry, is indicated in the following quotation from Wadsworth:[1]

While intelligence test results bear most directly upon intellectual capacity, standing in them is also a fair index to all around ability to adjust to the job. This is illustrated in the following table, where we compare the percentage of outstanding success

INTELLIGENCE	NUMBER	OUTSTANDING, %	PROBLEM, %
"Superior" (110 I.Q. or more)	154	40.5	10.8
"Average" (90 to 109 I.Q.)	312	29.8	19.3
"Below Average" (89 I.Q. or below)	207	12.5	35.4

versus failure on the job, in 673 cases. The data are compiled from ratings of our supervisors, who had no knowledge of test results. We use a three-point rating: (1) "Outstanding" which corresponds to "highly superior," (2) "Satisfactory" which is defined as "average," and (3) "Problem" which means a "poor hiring," "failure," or an "unadjusted employee." The percentage of "Satisfactory" employees is omitted in each case, as we are interested chiefly in comparing superior hirings with poor ones.

In studying individual lines of work a typical finding is that, of 10 men who score in the upper portion of the range for the occupation, 4 will be reported as "Outstanding," 5 will be

[1] WADSWORTH, G. W., JR., *Personnel Journal*, Vol. 14, No. 9.

"Satisfactory," and one a "Problem." In the lower portion of the range 1 will be "Outstanding," 5 will be "Satisfactory" and 4 will be "Problems." The relative chances of success in hiring above or below "critical points" revealed in a study of this kind are obvious.

Military Use of Intelligence Testing

The administration of the famous Army Alpha (language) and Army Beta (performance) tests constitutes perhaps the greatest single experimental project ever undertaken in the field of intelligence testing. A similar program of intelligence testing is in operation among the army forces in the present war. A rough outline of this use has been presented in the first chapter of the present text.

The U. S. Navy has also been making extensive use of intelligence testing. As early as 1925 a study of 1,000 men who had been in service for 1 year revealed that 218 of the men who had been separated from the service for cause showed a score of 52.7 on the classification test, that 445 who had not been advanced had an average score of 54.4, and 337 men who had been promoted showed an average score of 68.3.

In the following year, a study of 948 men showed that the use of tests permitted a reduction of those who had to be dropped from service owing to inaptitude from 20 per cent of the recruits to only 1 per cent. This early indication of the practicality of setting up a "critical score" was followed up, as shown by the fact that after 1930 the percentage of recruits accepted with scores below 50 dropped from 17 to less than 1 per cent in 3 years.

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Chapter 11

HUMAN ENGINEERING

In addition to the work on measuring general intelligence, much attention has been given in recent years to the analysis of special abilities. The determination of these special abilities, where possible, provides valuable aid in determining the vocation for which one is best suited. Employers also use the results of aptitude tests in the better placement of their men.

Motor Aptitudes. Psychologists have long been interested in the strength, speed, and coordination of various muscle groups. Professor Robert Seashore has recently shown that there is no general motor capacity. This means that special motor tests must be devised and administered for each function in which one is interested. Some of these basic functions with tests for each are listed.

1. Speed of movement.
   Test. Simple tapping test. Subject taps with a metal stylus on a metal plate. *Score:* Number of taps in 20 or 30 seconds.
2. Steadiness of muscular control.
   Test. Steadiness tester. Subjects attempt to hold a stylus in holes in metal plate without touching their edges.

3. Coordination.

   Test. Three hole tapping. Subject must tap so that stylus is inserted in each of three holes in succession. *Score:* Number of taps per minute.

   Another test of same: Tracing test. Subject draws stylus down a converging groove. *Score:* Distance moved before touching sides.

4. Strength.

   Test. Hand dynamometer. Subject grips dynamometer with maximum force. *Score:* Pounds of force as read on instrument.

5. Rate of Fatigue.

   Test. Ergograph. Weight is lifted successively in time with metronome. Isolated muscle group, such as one finger, used. *Score:* Various methods, such as number of minutes before finger fails to lift weight.

   Another test of same: Two plate tapping test. Subject taps alternately two plates 15 inches apart. *Score:* Number of taps first 15 seconds of 1-minute period compared to score of last 15 seconds of period.

The foregoing tests or adaptations of them may be of great value in vocational selection. By experimentation it is often possible to discover a relatively simple motor test that will measure the subject's ability for some specific industrial task. Examples of these tests are:

1. Spool-packing Test. Subject packs spools into trays of one dozen each. *Score:* Number of dozens packed in 3 minutes.

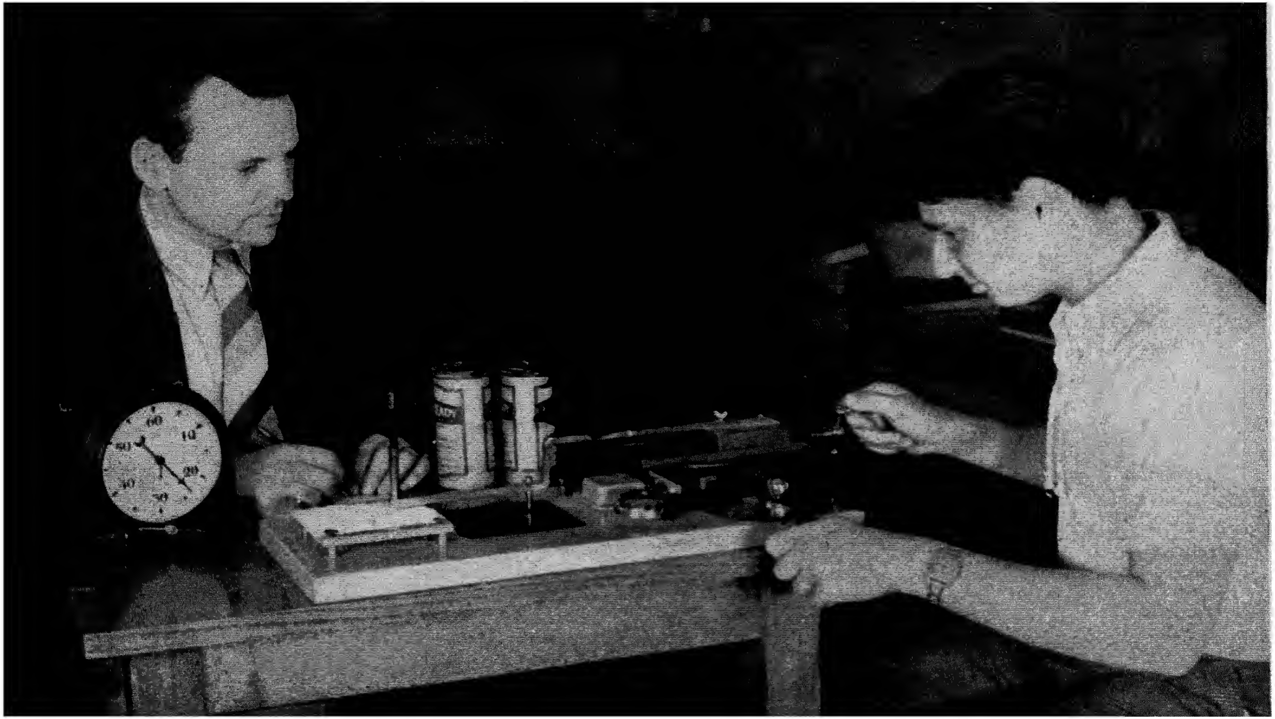

Fig. 33.—An aptitude test for lathe operators.

(Facing page 282.)

2. Nut and Bolt Assembly. Nuts are transferred from one row of bolts to another. *Score:* Number of seconds to make transfer.

3. Engine-lathe Test. A miniature lathe in which the subject must manipulate "cutting point" around a prescribed circle or other path. *Score:* Number of seconds to complete circle. Hull found this test to correlate +.45 with later actual achievement in lathe work.

4. Gottsdanker Test for Aptitude in Operating a Calculating Machine. This pencil-and-paper test was built up experimentally to determine aptitude for operating a key-setting type of calculating machine. Out of nine tests experimented with, three were chosen as providing the battery of tests with the highest degree of validity. These tests were a number-dot location test, an arithmetic computation test, and a tapping test. The multiple correlation of this group was +.57 where the criterion of validity was actual later performance in a calculating-machine course. This battery of paper-and-pencil tests, which shows a correlation somewhat better than that reported by Hull for his analogy test for the engine lathe, illustrates how the empirical method of testing building can be used to make a practical test that bears no obvious relationship to the performance being tested. More pencil-and-paper tests of reasonably good validity are needed if industrial testing is to continue to expand.

Mechanical Aptitude Tests. The ability to manipulate mechanical or concrete (as opposed to abstract) aspects of our environment is listed by Thorndike as a separate kind of intelligence. However classified, its measurement

is a central part of any psychological survey as related to vocational guidance or other aspects of life planning. Mechanical aptitude tests may be either performance tests or pencil-and-paper tests or combinations of both.

1. Performance tests measure ability by having the subject actually assemble miniature mechanical devices. Examples: Stenquist Assembly Test and Minnesota Assembly Test. The McQuarrie Test measures performance through pencil-and-paper analogies of simple motor ability.

2. Pencil-and-paper tests are usually based on extent of familiarity with the names or related functions of tools or other mechanical devices. Example: Stenquist Mechanical Aptitude Test.

3. Combination tests. Example: Detroit Mechanical Aptitude Test. Involves information and pencil-and-paper measurement of motor abilities.

The best tests have separate forms for boys and girls. Mechanical aptitude, like abstract intelligence, tests are usually related to past experience or training. Unlike the situation in abstract intelligence testing, however, the opportunities for training cannot be assumed to be equal. Thus, boys raised on farms will be almost certain to have higher average scores than those raised in the city. This factor must always be taken into consideration.

Stenquist has pointed out the twofold service the testing of mechanical ability can perform. If the subject has low general intelligence but high mechanical ability, the way is immediately opened for effective solution of a difficult guidance problem. If the subject is high in

both general and mechanical ability, there is a basis for narrowing down the field of choice, *i.e.*, selecting engineering instead of some abstract or academic occupation.

Social Aptitudes. The importance and measurement of social aptitude or social "intelligence" are discussed in detail in another chapter.

Artistic Aptitudes. The most outstanding work in measuring the capacities entering into artistic work is that of Dean Seashore and his colleagues at the University of Iowa. Seashore's most noted achievement has been the development of a series of tests for detecting native aptitude for music. The tests consist in the measurement, by means of phonograph records, of six fundamental requisites for musical expression. These records measure:

Sense of pitch
Sense of intensity
Sense of rhythm
Sense of consonance
Sense of time
Musical memory

Studies have shown that these capacities are independent variables. This means that a person may score high in some and low in others. Naturally a reasonably high score in all the traits is important to one planning a musical career. So outstanding have been the results of the use of these records that the Eastman School of Music requires all its applicants to pass this test before being admitted. Many other departments of music now use this method of separating those persons for whom a musical career is possible from those who would in-

evitably fail. In this connection Dean Seashore has remarked that he hopes his test may reduce the number of poor little children who, though devoid of musical ability, are forced by their well-meaning mothers into long, hopeless hours of practice at the piano!

In the field of the graphic arts, the Meier-Seashore and the Lewerenz art tests may be mentioned. The former is based upon the selection of the better of paired pictures, whereas the latter is more analytical and includes judgment of form, art knowledge, color recognition, and some actual drawing.

The Seashore music test has recently been revised so that the entire series of six basic musical abilities can be measured by responding to a series of three 12-inch phonograph records. The revised test thus takes only half the time of the original form. The six parts of the test remain the same as before except that the old form of the consonance test, which has been criticized on the ground that judgment of what constituted better or poorer consonance was a subjective matter, has been changed to a measure of the ability to distinguish differences in timbre. The Seashore test also is available now in two series. One is designed for measurement of the general public to determine its capacity for musical appreciation, and the other series is intended for the more analytical analysis of the abilities of those with specific musical ambitions. The author of this test gives the valuable warning, which might well be repeated, relative to the interpretation of the results of any single aptitude test. He says, "The rating on each talent is significant for musical guidance but many

factors must be taken into account; such as, other talents, musical interests and facilities, intelligence, vocational interests, voice, early achievement, time to study and willingness to work."[1] Failure to realize that psychological guidance is a technical matter requiring expert interpretation has led to many injurious consequences. Many people still persist in thinking that psychological tests are a form of magic and that once given the test score provides a kind of scientific horoscope that must be followed without reference to other factors.

Clerical Aptitude Tests. Despite the fact that vocational achievement is usually considered to be much easier to measure than is vocational aptitude, one is surprised to observe the limited amount of really good work that has been done in this field. Psychologists working at the University of Minnesota have done some of the best work that has been turned out. Outstanding among this work has been their aptitude test for clerks. The original form of the Minnesota clerk test consisted of 2 parts: a name-checking test and a number-checking test. The name-checking test seemed to produce the best results when used alone, since it measured general intelligence to some extent. Later forms of the test added measures of finger and general manual dexterity together with measures of mechanical assembly and spatial relations.

Validating studies[2] show that men clerks do, as a matter of fact, rate very much higher scores on this test

[1] SEASHORE, C. E., *Manual for the Seashore Measures of Musical Talent*, 1939.

[2] By Paterson and Darley. Students may use the Valentine reference given at the end of this chapter.

than do garage mechanics and that women clerks uniformly surpass women retail salespersons. It is evident from this study that tests must themselves be analyzed to discover whether all their component parts are functioning in a discriminatory way. It appears that some parts of this test are superior to others in this matter. Thus, although men clerks excel in the clerical numbers test and the dexterity tests, the garage mechanics get much better grades on the parts of the clerical test relating to mechanical assembly and spatial relations than do men working as office clerks. In the same way, women salespeople do nearly as well on finger dexterity as do women clerks. This does not mean, of course, that these parts of the test may not be useful in picking out good clerks, but it does mean that in themselves they cannot be used to distinguish between good clerks and persons good in other occupations. Fundamentally, our observations serve to emphasize the need of using as comprehensive a test as possible in even a relatively specific job such as clerical work.

Stenographic Proficiency Tests. The Blackstone stenography test may be taken as an example of vocational achievement tests in this field. This test measures proficiency in each of seven areas:

1. English
2. Syllabification
3. Office practice
4. Alphabetizing
5. Abbreviations
6. Business organization
7. Transcription

The test has been standardized on the basis of 1,000 high-school students, and the correlations of validity have been worked out with efficiency ratings on the job. One group of 37 stenographers showed a correlation of +.62 and another group of 49 showed a correlation of +.79 between test scores and job efficiency. Paterson comments regarding this test, "The validity indices may be regarded as satisfactory in view of the variety of factors other than ability that are likely to enter into efficiency ratings."[1]

Professional Aptitude Tests. It is not probable that there are special native aptitudes fitting one for the several professions. Certainly the one thing all professions require is a high level of general intelligence. Beyond this, however, it has been possible to devise tests that help show whether a person has the complex make-up of interests and abilities important for success in the various fields. Aptitude tests of this sort have been developed for the fields of law, medicine, engineering, education, and science.

That such tests do differentiate capacities of a given sort is illustrated by the Stanford Scientific Aptitude Tests. In Table 15 are shown the scores for men working

TABLE 15

Scores on Stanford Scientific Aptitude Test

(From Zyve, Stanford University Press)

GROUP	NUMBER	AVERAGE SCORE
Unselected freshmen	246	105
Research scientists	50	134
Science faculty	21	153
Nonscience faculty	14	118
Seniors and graduate, nonscience	47	90

[1] PATERSON, D. G., *Student Personnel Techniques*, p. 164.

in the field of science as compared with those in other fields.

Medical Aptitude Tests. An example of the professional aptitude test is the medical aptitude test designed by F. A. Moss. This test is made up of six parts designed to measure the following six abilities:

1. Comprehension and retention
2. Visual memory
3. Memory for content
4. Logical reasoning
5. Scientific vocabulary
6. The understanding of printed material

The test has been used so extensively upon applicants for admission to medical schools (over 90 per cent of the medical schools in this country are using it currently) that it is now possible to have a direct indication of its validity. Examples of its efficiency are to be found in the fact that out of the 100 highest scoring applicants from among 1,000 taking the test, 43 were rated as the best internes the hospital had, and only 5 were rated inferior. Similarly, another group that fell in the lowest tenth of the test failed 43 per cent of their members by the junior year in medical school, whereas of the upper tenth on the test only 2 per cent had failed. These practical results indicate that the test is "paying out." Moss's test is one of a relatively few professional aptitude tests that have been applied to a large group of students for a long enough period of time to make possible pragmatic tests of its predictive value.

Mechanics of Test Use. Many of the newer psychological tests, especially those relating to interests and

temperament, are likely to be fairly elaborate. It is usually not difficult to plan them so as to be nearly self-administering, but the task of arranging them so they can be scored accurately and at a moderate cost becomes a very real one. Many of the more widely used tests are now put out in form for machine scoring by having the answers punched or marked on special cards so that they can be run through sorting and scoring machines such as the Hollerith or the I. B. M. scoring machines. This treatment is excellent for large surveys and possibly even for large industrial uses but unfortunately contributes little to the place in which tests are more likely to be used, *viz.*, in small classes or counseling groups. A few testers have been ingenious in devising scoring forms. An excellent example of this is Kuder's Preference Record. In its self-scoring form the subject punches his answers upon an answer sheet (the entire test as we have seen is answered by selecting either *A* or *B* of paired alternatives). The answer sheet is arranged so that significant answers are indicated by punches coming within small printed circles. In this manner the subjects can score their own tests immediately if desired, merely by counting the punch marks that appear in this way. This makes it possible to score 360 questions in a very few minutes. The results can then be tabulated on a percentile rank basis and a profile drawn for comparison with typical profiles for various occupations.

Just as scientific work in the laboratory depends upon the development of effective new types of specialized apparatus, so the practical use of testing devices is in

part dependent upon the solving of these ordinary matters of mechanics.

The foregoing discussion indicates that the technique of testing ability and achievement has reached a high degree of complexity. Particularly in the industrial field, the question arises as to what is the best way to go about building a suitable test for a given problem situation. Poffenberger[1] has given us a useful classification of testing methods. These are:

1. The Sampling Method. In the sampling method the subject is asked to perform a series of activities which are actual parts of the duties he will be required to perform later. For instance, a sampling test for a stenographer would include taking dictation on a unit of material at a given rate of speed, in the field for which the stenographer was applying. Most tests which are concerned primarily with knowledge rather than capacity can make effective use of the sampling method. Thus, most vocational achievement tests (see below) are of the sampling type.

2. The Empirical Test. An empirical test is one in which it has been established, by experimentation, that there is a correlation between the test score and later performance on the job. Test situations can frequently be devised which, while they show no obvious relation to the job at hand, do nevertheless indicate one's ability in it. These tests are worked out largely on the basis of trial and error and the question as to how effective a given test is can be determined only on the basis of a careful follow-up study of the persons tested. In other words, if persons making a high score on a given test do uniformly succeed on a given task, then that test is a good vocational test regardless of its content. The advantage of this testing method is that tests which are fairly easy to administer may be available while it would be very expensive or otherwise difficult to administer a "sampling" test. An objection to this type of testing may be that the test

[1] POFFENBERGER, A. T., *Applied Psychology, Its Principles and Methods*, p. 316.

seems illogical to the subject. In certain situations such as civil service examinations, it is important to give the subject a test which "looks reasonable" rather than have him go away saying that "they asked me a lot of fool questions which had nothing to do with the job."

3. The Analytic Test. This type of test approaches the problem from exactly the opposite angle of that of the empirical test. The attempt here is to break down a total performance into its component parts in the hope that these part functions will be simple enough to be measured by purely objective devices and in the hope that the sum of several of these part scores will provide an indication of the capacity of the individual. The Seashore music test is an excellent example of this method.

4. The Analogy Test. In the analogy test the original performance is condensed into a test situation which is similar to the task for which one is testing. Many driving tests are analogy tests as is Hull's test for power-lathe operators (Fig. 33). In this test a miniature lathe is provided, the operation of which is in most respects, the same as that which will be used later.

It should be clear that these methods will have varying degrees of utility according to the situation with which one is concerned. The point should also be made that the various types of tests may be blended together in one complete testing program. In short, the industrial psychologist or the educational counselor, as the case may be, wants to know which of several persons is most likely to excel on a given job. Any preliminary performance survey or combination of surveys that correlate highly with later success on the job will be satisfactory. Expediencies of testing materials available, expense of administration, the nature of the job itself, and even the ingenuity of the test builder will all enter into the determination of the final test setup that will be used.

Psychology and Personal Efficiency

Environmental Factors. The psychological effects of climate have long been recognized. Huntington goes so far as to attribute the rise and fall of nations to slight changes in climate. He thus attributes the decline of Greece to climatic changes resulting in the spread of malaria with its devitalizing effects! Not all students are willing to accept the extreme views of Huntington and his "geographic" school of thought, but the effects of climate on the vitality and resourcefulness of people are generally accepted. Hot climate seems to favor emotionalism and speculativeness, whereas people of the temperate zones are more inclined toward inventiveness and physical activity. Statistics show that murder is highest in southern Europe, whereas the lassitude that descends upon the white settlers in the tropical zones is traditional. Environmental influences upon personal efficiency can be more objectively measured as related to seasonal changes. It has been established that crimes of violence against persons reach their peak during the summer, whereas crimes against property (nonemotional) reach their peak during winter.

> In the spring a young man's fancy lightly
> turns to thoughts of love.

All nature bears out the poet's observation of the relation of season to sexual emotions. Thus, unfortunately, sexual crimes and other crimes of violence reach their peaks at the season traditionally characterized by the annual crop of June brides.

Most of us have little choice as to the locality in which we shall live. We can, however, bear in mind the effects of climate and seasonal change upon our efficiency and so plan our work as to be least affected by adverse conditions. The closing of schools and the general practice of summer vacations from business illustrate sensible concessions to the weather.

Variation in efficiency with the time of day is very marked and offers a situation of which the average person should take greater advantage. Studies generally agree in showing the morning hours to be the period of greatest efficiency. Hollingworth found that the period of greatest efficiency was reached 3 hours after work began. The implication of this is obvious. Difficult or original work should be undertaken in the morning and routine tasks reserved for the afternoon. The tendency of most of us is just the opposite, we tackle routine tasks first so as to "clean our desks" only to find most of our enthusiasm for new tasks gone by the time we are ready to do them.

Late evening hours so often prized by workers are actually the least efficient time to work. The only real defense for night study lies in the reduced amount of distraction.

The importance of properly spaced rest periods for both mental and physical work, as shown both by ergograph studies and by the work on memory should be applied in planning one's work day.

Sleep. Like work, sleep is most efficient during its early hours. The ingenious studies of Johanson and others have shown that it is true that some people

sleep "faster" than others. Very few people "sleep like a log"; these studies show that normal sleep is accompanied by a certain amount of changing of position. The key to restful sleep is the same as that found by Jacobson for rest in general: relaxation. The more complete the relaxation the "faster" will one sleep.

Our newer knowledge of sleep indicates that sleep like work might well be broken up into shorter periods. Most of us could profit greatly by adopting the "siesta" or short midday nap. Because of the noonday meal our efficiency is markedly lowered at this time. Complete relaxation for an hour or so would change a period of drudgery into one in which our energy could be given a marked boost.

The thoughtful student may well be impressed by the simplicity of the principles underlying the attainment of personal efficiency. The tragedy is that, being so simple and universally known, they are so often merely talked about instead of acted upon.

Illumination. Lighting systems are usually classified under three headings.

1. Direct. Light comes directly from its source to the working surface.

2. Indirect. Light goes from its source to the ceiling, wall, or some other reflecting surface and then to the working surface.

3. Semi-indirect. This may mean that the system is a combination of the above types or that the light comes directly from the source but is diffused by frosted glass. Probably the majority of lighting systems now used would be classed under this heading.

The watchword in planning lighting is "avoid glare." Glare merely means extreme differences in intensity in a local area such as on a desk. The present-day insistence on indirect lighting means only that indirect lighting is most likely to provide uniformity and avoid glare. It should be remembered that the effectiveness of the indirect lighting will depend upon the nature of the reflecting surface. A perfectly smooth white surface may produce nearly as much glare as the light source itself. Similarly a dark-colored surface will absorb much of the light, thus requiring abnormally large bulbs for adequate light on the working surface. If ceilings and walls are of soft, light-colored material, the best lighting fixtures will be those consisting of a plain metal reflecting bowl that directs the light upward. At the present time it is possible to purchase lamps that bear the mark "I.E.S." This stamp of the Illumination Engineering Society can be used as assurance that the lighting fixture meets at least the minimum requirements for effective lighting.

In connection with the problems of uniformity one other psychological fact should be taken into account. There is a reflex tendency for the eyes to turn to the point of highest illumination. An early indication of properly developing coordination is the test of whether the eyes of the three-month-old infant will fixate upon and follow the movement of a burning match or candle. If, therefore, illumination cannot be 100 per cent uniform, care should be taken to see that the working surface has slightly more light than surrounding areas. Otherwise the eyes will tend to be pulled away from the

work. Especially to be avoided are those desk lamps whose shades are partly transparent. Often of attractive shades of green or other color, they are a constant deterrent to concentration. If a desk lamp is to be used, it should be of fairly low intensity (the writer finds 25 or 30 watts to be ample), the shade should be of metal or other entirely opaque material, and the light should pass through a frosted glass before reaching the desk. The question as to where the light should come from is relatively unimportant so long as the page being read is the most brightly illuminated part of the visual field and so long as it is uniformly lighted and entirely without shadows. The old idea that light must come over the left shoulder grew out of the fact that with direct light (floor or ceiling lamps) the light bulb had to be behind to avoid a spot of intense light in the visual field. Light coming over the left shoulder would be least likely to cause a shadow from the writing hand and pen to fall on the page.

Seven Things to Look For[1]

For comfortable, effortless seeing in your own home, check up the lighting, considering these seven major points. Make sure there is "enough light in enough places" for every member of the family.

1. *Direct Glare: Are there any lamp bulbs wholly or partially exposed to the eyes?* This is a definite lighting defect, and should be eliminated by shading all bulbs, and by placing portable lamps slightly to the rear of chairs or davenports. Shades of heavier material help to reduce glare. Light is made to *see by* not to be *looked at.*

[1] Reprinted by permission of The Western Institute of Light and Vision, Los Angeles, Calif.

2. *Reflected Glare: Are there any annoying high-lights or reflections on or near the work to which the eyes are assigned—on the page, top of desk, etc.?* If so, they may be eliminated or modified by changing the position of the lamp or work slightly, so that the light strikes the work at an angle that directs the light away from the eye rather than into it.

3. *Quality: Are there harsh dark shadows on your work if you hold your hand between the light source and the work?* The glass diffusing bowl of modern safe-seeing portable lamps and fixtures softens these shadows.

4. *Adaptability: Does each lamp itself or the whole lighting arrangement in the room offer flexibility for various uses?* There should be good lamps for every seeing purpose in the room—and enough of them so that all seeing tasks may go on simultaneously without having to move lamps about.

5. *Intensity: Is the footcandle reading at each visual task in keeping with Footcandle Recommendations for the home?* If you call in a lighting adviser from your electric service company the intensity in various parts of the home will be measured for you.

6. *Contrast: Is the footcandle reading throughout the room at least one-tenth that of the brightest part of the room?* The light meter readings are necessary to determine this important point.

7. *Decorative Harmony: Is each lamp itself, or each furniture grouping of which each lamp is a part, pleasing to the eye from any location in the room, and in keeping with sound decorative principles?* There is the right lamp for each desk and each furniture grouping.

How Much Light Is "Adequate"?[1]

It is difficult to lay down hard and fast rules to cover all of the various phases of home lighting. Many lighting effects, such as that of the dining room, may be purely a matter of decoration and personal taste. However, when any room or area is used for study, sewing, or other tasks involving constant use of the eyes—then care should be taken that adequate amounts of illumination

[1] Sorensen, Royal W., E. E., professor of electrical engineering, California Institute of Technology, Pasadena. Reprinted by permission of The Western Institute of Light and Vision, Los Angeles, Calif.

should be supplied. Research has determined the minimum amounts of light to be employed for such seeing, these amounts being known as "adequate."

The following recommendations for lighting intensities are based on the researches of Dr. Matthew Luckiesh and Frank K. Moss of the Nela Lighting Research Laboratory, Cleveland. In these recommendations "Local" lighting is the light directly on your book or other visual task. "General" lighting refers to the light level throughout the room. If unpleasant and tiring contrasts are to be avoided, the general lighting should have at *least one-tenth* the brightness of the local light.

1 *to* 5 *Footcandles:* For visually controlled work not involving fine discrimination, such as card playing.

10 *to* 20 *Footcandles:* (General plus Local lighting.) For moderate, but not prolonged, visual tasks, such as: Reading good print on white paper; sewing on light goods; coarse knitting; crayoning and other play projects of young children where no very fine discrimination is necessary; work places in kitchen, laundry trays and ironing board.

20 *to* 50 *Footcandles:* (General plus Local lighting.) Recommended for moderately critical and fairly prolonged visual tasks, such as: Reading newspapers (fine print on poor paper); prolonged sewing with light thread on light goods; stamp collecting; drawing and similar crafts; wood or metal working; sewing at sewing machine; shaving and make-up; fine knitting, crocheting, darning and mending; children's home work and close reading.

50 *to* 100 *Footcandles:* (General plus Local lighting.) Recommended for severe and prolonged visual tasks involving discrimination of fine detail, such as: Difficult reading for prolonged periods—particularly of very fine print on thin, uncoated paper; sewing with dark thread on dark goods; home drafting and associated intricate tasks requiring visual concentration on very minute detail.

1 *to* 5 *Footcandles:* (General lighting.) Recommended levels throughout rooms that have localized lighting units which can provide 10 to 50 footcandles when desired.

5 *to* 10 *Footcandles:* (General lighting.) Recommended intensities throughout rooms which have localized lighting units providing

10 to 100 footcandles. The following rooms should certainly have 5 to 10 footcandles of general illumination in addition to the necessary localized lighting:

> Children's playroom; kitchen; laundry; sewing room; workshop; library or reading room.

The recommended intensities do not mean that your home should be "ablaze with light." There are times when you wish to sit and converse with friends in the twilight, virtually no eye work being involved. The important thing is that there should be available, when and where you want it, adequate light for the seeing task at hand. These recommendations, while referring particularly to the home, are equally true wherever the eyes are used for close seeing.

Controlling Daylight

Many times in the past, not enough attention was paid to having adequate windows in the home that comfortable vision would result in the daytime. When the window areas are small . . . the *contrast* between the *dimly* lighted interior of the room and the *brilliant* out-of-doors light is trying on the eyes. Too often, the effect while indoors in the daytime, is like looking in the open door of a furnace.

For this reason, specialists in vision and lighting have welcomed the recent trend towards larger window areas in homes . . . also the use of venetian blinds and similar shades which reduce contrast and make the daylight which enters . . . more useful. For best seeing conditions, every effort should be made to keep the difference in brightness between the window and the room as low as possible.

Despite what has been said about the secondary importance of intensity in illumination engineering, it remains true that most workrooms are inadequately lighted. The working surfaces of a study, shop, or sewing room should have the equivalent of 10 foot-candles of illumination. The total number of watts of light needed

for a workroom can be roughly determined by multiplying the number of square feet in the room by two if semi-direct light is used or by four if full indirect light is used.

All that has been said about lighting refers to *workrooms*. It should not be inferred that living rooms or other rooms used for relaxation need to be "lighted up like a Christmas tree." Neither should anything that has been said be taken as opposing the use of light for ornamental purposes. Correct blending of shadows can produce a very soothing and pleasant effect and may be used as dictated by the best that one can learn as to artistic value.

SUGGESTED READINGS

CRAFTS *et al: Recent Experiments in Psychology*, Chap. 16.
GRAY, J. S.: *Psychology in Use*, Chap. 2.
GUILFORD, J. P.: *Fields of Psychology*, Chap. 17.
HEPNER, H.: *Psychology Applied to Life and Work.*
LAIRD, D.: *Increasing Personal Efficiency.*
LUCKIESH, M.: *Seeing and Human Welfare.*
VALENTINE, W. L.: *Experimental Foundations of General Psychology*, Chap. 3.
VITELES, M.: *Industrial Psychology.*

Chapter 12

PLANNING YOUR FUTURE

IN attempting to approach the problem of one's life work, two fundamental questions present themselves. One wants to feel assured that the work one is to follow will provide personal satisfaction and happiness, and that it holds reasonable promise of material success. In addition there is to be considered the question of the social worth of a given vocation. It is not easy to find a basis upon which to decide which vocation is most likely to meet these needs for any given individual. In the present chapter we wish to obtain a bird's-eye view of the student's abilities, as treated thus far, in the belief that a consideration of these results as a unit will contribute much toward successful life planning. In addition to the information already obtained, we shall consider the role that one's vocational interests may play in helping one arrive at a chosen vocation.

Vocational Interests

Two important questions present themselves in considering the problems of vocational interests. Do vocational interests reflect vocational ability, and, secondly, do vocational interests indicate probable employment

and personal satisfaction in a given line of work? In attempting to answer these questions several tests for measuring interests have been devised. Outstanding among these is Strong's Vocational Interest Inventory. By means of a very thorough questionnaire approach, Strong obtains a group of reactions which may be scored by separate keys so as to show how closely one's interest coincides with the interests of persons who have achieved success in several fields. According to the scores obtained, it is possible to answer the question of whether the interests of the individual are characteristic of a particular occupation. A score of *A* indicates that his interests do coincide with the given occupation, a score of *B* indicates "not sure," and *C* indicates that the interests are not those of the given group. Research by Strong and others shows that comparatively few people outside of a given occupation rate *A* in the interests of that occupation. This does not mean, of course, that persons scoring *A* in a given vocation should necessarily enter that vocation. It does mean, however, that if their measures of ability show them capable of the vocation in question and if they have no other *A* ratings, they will be most likely to succeed in the vocation considered.

As to whether interests reflect abilities, the evidence is not conclusive. Studies by Thorndike indicate that statements of interest predict vocational success about as well as do measures of ability given at the fourteen-year-old age level. Neither measure at this age, however, is particularly significant. On the other hand, data based on the Strong Vocational Interest Blank show an important relationship between abilities and

interests. Thus among 181 life insurance agents only 2 per cent of those rating *A* in life insurance interest did a gross business of less than $50,000 while 41 per cent of those rating *A* did a gross business of more than $200,000. Of those rating *C* in interest 75 per cent did a gross business of less than $100,000 and none did a business over $200,000. Of interest also is the fact that of the 181 life insurance agents, 105 received *A* ratings whereas only 16 received *C* ratings.

The question of the relation of interests to probable satisfaction in given lines of work may be approached through the study of the permanence of interests. We may perhaps assume that a person will enjoy a line of work if he is interested in it. The question then becomes, will he maintain his interest through a significantly long period of time? Strong's results from studying this problem would indicate that the measurement of interests at the college level gives a more stable picture than interests measured at an earlier age. Thus in measuring the permanence of interests over a period of one year, Strong found that the correlations for college freshmen as related to the five vocations of engineer, physician, minister, lawyer, and accountant averaged in each case almost exactly 10 points higher than did the same tests when given to high-school juniors. A difference of 10 points in correlation is a very significant matter. In another study by Strong of the stability of interest over a period of five years, the average corrected correlation for 21 different vocations was +.84. This measure of reliability in terms of retest is almost as high as the reliability of certain intelligence

tests. This test would seem, therefore, to provide an interesting and helpful basis for determining those interests which are likely to be more or less permanent. The results of a study of the degree to which occupational interests overlap are indicated in Table 16, in which men in 18 occupations were rated on the engineering scale. The table shows that, as would be expected, the engineers obtained the highest ratings. Following in order are those vocations which have elements of engineering interests in them, such as chemistry, farming, and architecture. At the lower end of the list we find advertising men and life insurance salesmen among whom there were no individuals obtaining *A* ratings in engineering interests.

TABLE 16

Extent to Which Men in 18 Occupations Are Rated for Engineering Interest
(From Strong, Stanford University Press)

	PERCENTAGE RATED		
OCCUPATIONS	*A*	*B*	*C*
Engineers	75	23	2
Chemists	47	50	3
Farmers (agricultural college graduates)	37	49	14
Architects	34	54	12
Psychologists	24	46	30
Physicians and surgeons	22	53	25
Personnel managers	19	36	45
Purchasing agents	14	56	30
Public accountants	13	51	36
School teachers and administrators	12	46	42
Lawyers	8	39	53
Journalists (newspaper editors)	7	31	62
Artists (painter)	6	49	45
Real estate salesmen	4	28	68
Authors	3	33	64
Ministers	2	25	73
Advertising men	0	35	65
Life insurance salesmen	0	23	77
Average for all above except engineers	15	40	45

The student must by no means assume from the preceding discussion that he can determine the vocational choice on the basis of his score in vocational interests. The problem is such a complex one as to require all the evidence that can be brought to bear on the question. Even then a certain amount of trial and error may be necessary before the line of work to which one is to devote one's life can be definitely settled upon. Of particular importance in this connection is the fact that vocational interests sometimes reflect emotional attitudes acquired in childhood. These attitudes frequently have no relation to a knowledge of the vocation itself so that unless actual contact can be had with the work, the student may be led to making a choice that would prove unfortunate. The better measuring scales such as that by Strong avoid this difficulty to some extent, but it is always desirable for the student to have actual firsthand contact with a vocation before he forms final opinions relative to it. This firsthand contact can often be gained through work during summer vacations or in part-time work during school. Wherever possible the student should avail himself of the information that can be obtained from a good vocational interest study and should incorporate the results in his general psychogram as discussed in the following pages.

Kuder Preference Record. Among the newer tests for vocational interests is the Kuder Preference Record. This test operates by the principle of paired comparisons through asking the subject to indicate which of two activities he would prefer. The alternatives offered are so arranged as to provide paired comparisons

on activities relating to seven types of professional work. These are:

1. Scientific
2. Computational
3. Musical
4. Artistic
5. Literary
6. Social service
7. Persuasive

In addition to the excellent quality of the statistical work that has gone into the test, it has the real advantage of using question propositions that do not sound forced and will be likely to appeal to the average subject as being "sensible." For instance, he is asked whether he would prefer to live in a city or live on a farm; whether he would prefer to design a new automobile or to try out the new automobile; whether he would rather be an accountant or an inventor; whether he would rather manage a fine restaurant or be a psychologist; whether he would prefer to own a good dog or a small telescope; whether he would rather be an author or be an artist. Questions of this type give the subject something concrete to work upon and probably help in getting a realistic picture of his real basic interests.

Kuder stresses the important point that "these scores are not measures of ability but are meant to give some index of the extent to which an individual will be motivated in various areas to use the ability he possesses." The further important point is made that since a statement of one's preferences may or may not reflect one's

ability, the counselor should always include with the use of the preference profile a consideration of measures of ability. As a matter of fact, a study by Adkins shows that the correlations showed uniformly low positive correlations (about +.30) between certain of the preference scores and scores on various mental abilities tests. Other studies indicate that, whereas the scientific, literary, and computational tended to correlate positively with average college grades, persuasive, artistic, and social service scores correlated negatively with college grades. These facts, rather than indicating a weakness in the test, merely substantiate the fact that an interest test is not intended to be and should not be interpreted as a test of ability; rather it relates to a unique and important psychological factor—interest in one's work—which is a matter of intrinsic importance in vocational counseling.

A final characteristic that may be noted regarding this test and one that the writer believes to be in its favor is the fact that occupations are pooled into groups that may properly be assumed to utilize the same underlying interest types. For instance, interest in using a microscope, performing laboratory experiments, visiting scientific apparatus exhibits, and trying to fix a vacuum cleaner may all be symptomatic of a type of interest that could find a satisfactory outlet in the work of a chemist, inventor, psychologist, laboratory technician, pharmacist, science teacher, or explorer. In a similar way, a basic interest in literary activities might underlie any one of a number of professions including author, teacher, literary critic, proofreader, secretary, or librarian.

Personality and Social Values

One's personality can be approached through a study of those aspects of one's social world which most interest one. The German writer, Spranger, in his *Types of Men* has developed a theory by which he classifies people into six groups. Each of these groups refers to a fundamental social interest, or "value," as he calls it. One's total personality is viewed by Spranger as a composite made up of the presence or the absence of these six traits. Every student should carefully consider these six traits and, if possible, obtain a measurement of the degree to which each of them is present in himself. Such a study will help tremendously in understanding the forces that are working to determine the direction of one's own personality development.

A knowledge of these six types, together with an understanding of the relative importance of each in one's personal make-up, should go far in contributing toward self-understanding. Persons who find themselves in lines of work that are markedly different from their own fundamental interests are likely to be dissatisfied and to experience a sense of repression. A brief description of each of the six types will, perhaps, be most helpful in showing what the probable social applications of the test are.

1. *Theoretical Type.* Persons in whom the theoretical interest predominates take an intellectualistic attitude toward life. Their fundamental interest lies in the discovery of truth. Truth, as viewed by the theoretical type, can be attained best, and perhaps exclusively,

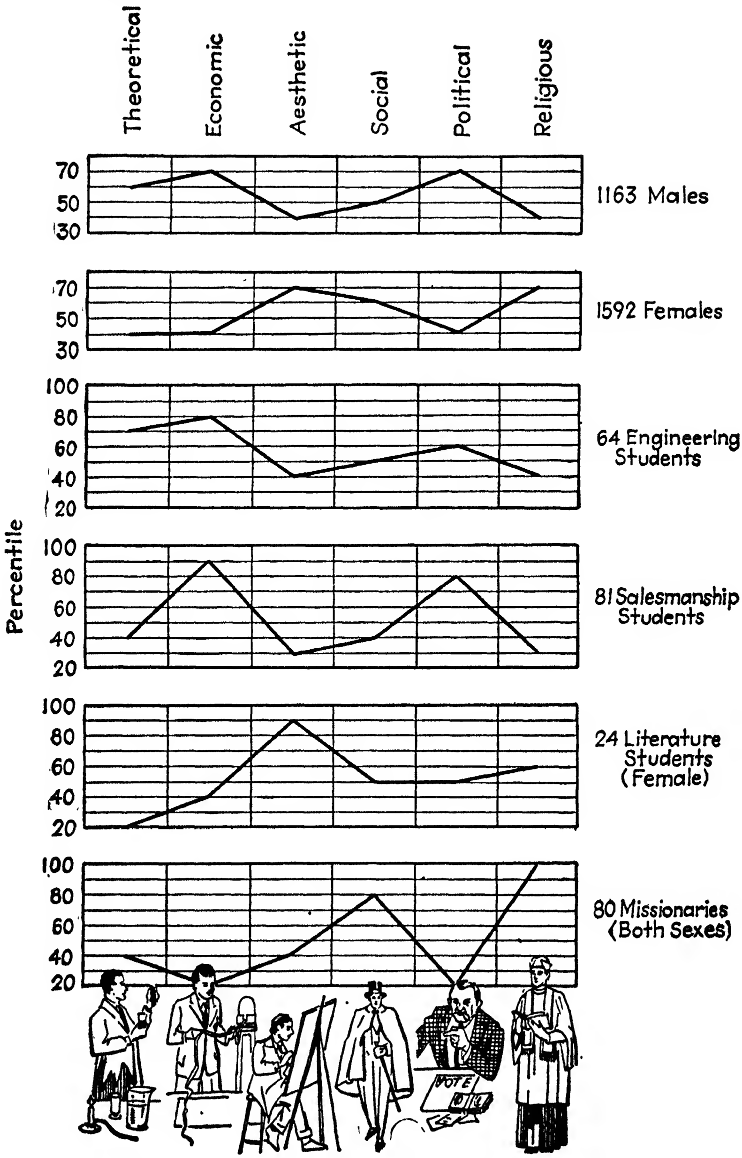

FIG. 34.—Characteristic percentile ranks on social values test. (*Adapted from Allport and Vernon.*)

through the observation and systematization of knowledge. This type of person is critical of any such sources as mysticism, intuition, and the like. His interest in the discovery of truth through rational methods frequently results in a lack of stress upon such problems as beauty or utility. The philosopher and the scientist best typify this fundamental value.

2. *Economic Type.* By economic type Spranger does not intend to refer primarily to an interest in financial matters or economics. His concept is broader in that an economic type concerns himself with practical problems. His point of view is that which the philosopher would call pragmatism. The original source of this interest is the need for the satisfaction of physical needs. The average American businessman well illustrates this type. The economic type is likely to be little concerned with aesthetic values or with ultimate problems of a political or philosophical nature. Rather than deal with fundamental problems of life, he is perhaps more inclined to accept conventional points of view regarding religion and politics.

3. *Aesthetic Type.* Persons in whom the aesthetic value is strong find their greatest values in beauty. Although not necessarily a creative artist, the aesthetic type reacts to his world with the "artistic" sense. Mencken has been quoted in characterizing the aesthetic type when he said, "To make a thing charming is a million times more important than to make it true." One definition of religion makes the religious attitude almost synonymous with the aesthetic type in our present sense. Persons who find in religion occasion for

the contemplation of the beauties and grandeur of nature and who are thrilled by the pomp and ceremony of a great cathedral service may be reacting to the aesthetic values rather than to the religious ones in their narrow meaning.

4. *Social Type.* The fundamental characteristic of the social type is his love of people. His fundamental values are the warm personal contacts with other human beings. Religion, art, money matters, truth itself, are seen as they relate to his fellow man. In the social type we find great teachers, social reformers, and religious workers.

5. *Political Type.* Power is the primary value for the political type. Power is desired for its own sake, and not merely as a means to money or any other value. The presence of this fundamental value helps explain why many persons will go into politics, serve faithfully and honestly, and even expend their entire personal wealth just to maintain themselves in a political position. Where the political type becomes allied with suitable other values so that he is not led into antisocial action, we have developed a high type of politician. Probably a combination of political value with high social value would represent the ideal in this respect.

6. *Religious Type.* By the religious type we mean more than a tendency to adhere to any one religious sect. The religious type seeks ultimate truth and ultimate value. In this respect he is similar to the theoretical type. The difference between the two lies in the method through which truth and ultimate value are sought. In a word, the religious type is mystic; he seeks truth

through striving to attain immediate contact with supernatural sources of knowledge. This type is properly called the religious type because of the fact that the fundamental tenets of most religions are related to divine revelations.

Mixtures. It is of fundamental importance to understand that individuals usually do not represent pure types according to the above classifications. Each individual is a mixture of these types. Indeed, the social values test operates, not by trying to measure the absolute strength of each of these qualities, but rather by determining the relative strength of each; thus, a person may be extremely high in one of the six, moderately high in two others, and quite low in the remaining three traits. A knowledge of the outstanding interests and combinations of interests in one's own personality opens the way to self-understanding and suggests lines of work and fields of social experience which are most likely to be satisfying to the individual.

Allport and Vernon have devised an excellent personality inventory (A Study of Values) based on Spranger's theory. By asking the subjects to make choices as to possible lines of conduct in social situations and to state preferences as to fields of work, they arrive at scores representing the relative importance of the several values in the lives of the subjects. That the test does differentiate between groups and that various groups do have different basic social values is demonstrated by the average percentile rankings shown in Fig. 34, and by the tentative occupational interest profiles of students (Fig. 35). This test, like Kuder's

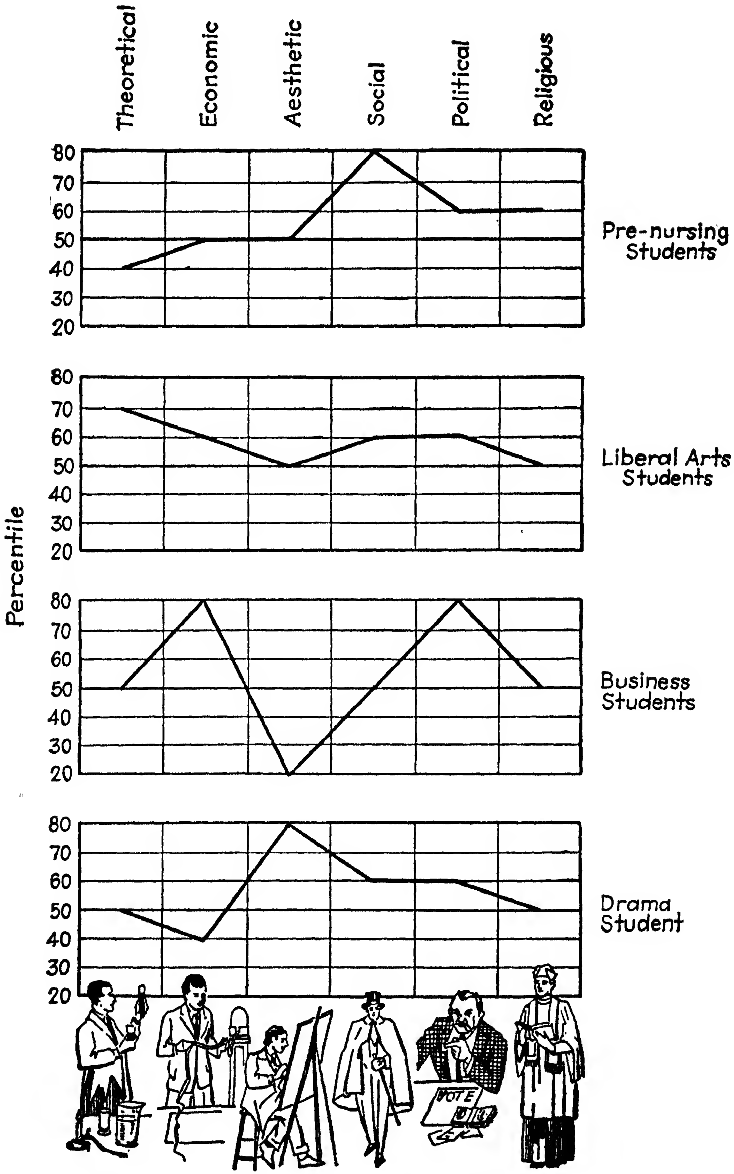

FIG. 35.—Tentative profiles for students with various occupational interests.

Preference Record, measures interests in terms of interest fields rather than in terms of the specific occupational interests of lawyer, mechanic, doctor, or farmer. The Study of Values Test also indicates that a student's occupational ambition will in most instances lead to characteristic interest profiles.

Social Intelligence. In our discussion of the theories of intelligence, we presented Thorndike's view that there are many kinds of intelligence, each a more or less unique ability not necessarily related to other abilities. In his simplest classification, he lists three basic kinds of intelligence: abstract intelligence, social intelligence, and mechanical intelligence. We have already considered abstract intelligence, the ability to deal with symbols, and mechanical intelligence, the ability to manipulate actual objects around us. Social intelligence, if there be such a special type of ability, would certainly be an extremely important factor in one's general personality. From one point of view it might almost be said to be all of personality since personality is frequently defined as the sum total of one's social behavior. Social intelligence is usually defined as the ability to learn the most effective forms of social behavior. Some psychologists following Spearman believe that this ability is merely one aspect of a person's general flexibility or adaptability. They might even show that it draws elements from both mechanical ability and abstract ability. In other words, one's table manners may be a combination of the ability to remember the symbolical phrases from Emily Post as to which fork to use with a given food together with a type of actual muscular coordination

and finger construction which permits one to pick the fork up and handle it without knocking the salad onto the tablecloth. There are probably cases in which a person may be very apt and even graceful as an athlete and yet, because he does not know what to do, is a complete failure in the drawing room. In a similar way one may think of a clumsy and pompous person who knows exactly what is expected in any given social situation but who does these things so awkwardly as to be a source of amusement and even embarrassment to those around him.

Measuring Social Intelligence. Regardless of the psychological theories relating to social intelligence, its measurement remains an important task. One of the most outstanding attempts to measure it is that of Dr. Moss of George Washington University. For purposes of measurement Moss has analyzed social intelligence into five parts:

1. Judgment in social situations.

2. Recognition of the mental state of a speaker. In an earlier form of the test this centered around the ability to judge emotions and other mental states from facial expressions. Later on, the form was changed to become a test of one's ability to interpret correctly the social meaning of certain popular phrases such as, "Drink as much wine as you please, but preach the benefits of water."

3. Observations of human nature. If one can correctly anticipate the reactions of persons to certain stimuli, one can modify one's behavior so as to avoid negative reactions. This part of the test presents situa-

tions in true-false form and asks the subject's judgment on them. For instance, "Do most men dislike to take orders from a woman?" or "Do most people appreciate having a frank criticism of their faults?" It may be commented that such a test may very well measure the subject's own attitude toward society as well as his ability to judge other people.

4. A most interesting part of the test is the test of memory for names and faces. Nearly every one of us is frequently made acutely aware of his inability to recall the names of persons he has met recently. The "lame duck" excuse, "I remember your face perfectly but just can't recall your name," illustrates the universality of this failing. This part of the Moss test presents pictures and names of persons for a few moments and then later tests the subject's ability to associate the names and faces correctly.

5. Sense of humor. The understanding of a joke usually turns on the appreciation of some finely shaded point in social relationships. This is why jokes usually cannot be translated from one language to another. It is as often that the cultures are enough different so that the joke is pointless as it is that the languages themselves are different. Similarly, there is no quicker way to show yourself up as a socially awkward person than to tell jokes that are either too much "off color" in one circle or too "sissified" in another meeting such as a men's club. In addition to this part of Moss's test, other men such as Roback have made whole tests on sense of humor. Nearly all such tests, though theoretically excellent, fall victim to their own subject matter, *viz.*,

the jokes themselves fail to measure because they "fall flat" in the social situation in which they appear or go too far, or because our rapidly changing times render a joke obsolete after a short period.

Validity of Social Intelligence Tests. The Moss test and most others in this field have been strongly criticized as to their validity. We have already seen that there is some reason for suspecting that the thing called social intelligence represents merely a specialized use of abstract intelligence, together with the factors of physical structure and muscular coordination. As a matter of experimental fact the scores on the social intelligence tests frequently show a pretty high positive correlation with scores on general intelligence. This tends to suggest that both are measuring the same things. Some groups, such as executives and teachers, who might be expected to show high social intelligence in their work, possess much higher scores than do such persons as industrial workers and office clerks. On the other hand, there is a remarkable similarity in the order of scores between the median I.Q. of various occupations and median scores on the social intelligence tests for the same occupations. For instance, nurses and policemen, both of whom certainly should be expected to have high social intelligence, fall very low in this test, but we find that they also fall low in general intelligence. Engineers, draftsmen, and electricians, who would seem to have no intrinsic necessity for great social intelligence, nevertheless rate fairly high, and we know, of course, that these groups are high in general intelligence.

The upshot of this debate tends to result in the view that social intelligence might better be called social achievement and be tested for as such. There is no question that some people with high general intelligence may have failed to use that general intelligence in the acquisition of social graces. The individual employer or counselor will probably have as his immediate problem the task of finding out whether a given individual is at the moment capable of functioning in a socially correct way. If a test can be devised that will give this information it would seem to meet its most important task.

Vocational Guidance

To be adequate, vocational guidance must incorporate the results of a comprehensive view of the individual's abilities and of the social situation in which the individual will probably find himself. In times that are changing as rapidly as they are today, it is extremely hazardous to attempt to predict the relative opportunities to be found in the future in the different occupations. Our present interest centers, then, around the survey of the individual's abilities. These abilities may be summarized and presented graphically in the form of a psychogram. The psychogram usually takes the form of a line graph showing how each of the individual's abilities compares with the average for the group. Once such a psychogram is available, it becomes an easier matter to segregate one's strong points so as to capitalize upon them. Similarly, through a knowledge of one's weaker points, one can avoid lines of work which make strong demands upon these capacities.

The individual can also remedy certain of these weak points by paying special attention to them.

General Intelligence and Vocational Guidance. The level of general intelligence is a factor more important than any other measurable trait for determining the field of vocational activity. Studies originating with the work on the Army Alpha Tests show that there is a definite relation between the occupational groups and levels of intelligence. Table 14 shows the average intelligence requirements for a group of occupations. In this connection it should be pointed out that one may have too much intelligence for a given line of work as well as too little. Where there is too much intelligence the difficulty usually lies in the fact that the individual finds the work boring and thus becomes discontented and tends to do his work carelessly. One must not view the data in such a table in a slavish manner. Intelligence test results constitute at best limit-setting factors. This means that a given level of intelligence may preclude the possibility of certain lines of work requiring a level of intelligence greater than that one possesses. Within the range of one's level of capacity, however, the field of vocational choice is entirely open except as it may be limited by special abilities or handicaps.

Tests of special abilities, like tests of general intelligence, operate to establish limits to effective vocational work. This idea has been expressed in the statement that most tests are "negatively diagnostic." This means that properly used tests limit fields of activities and indicate lines of work we probably *should not* attempt to enter rather than indicating positive fields

we should enter. Thus if a person has a high score both in general intelligence and in mechanical ability, the question is still open as to the most useful field for expression. If he be high in mechanical ability and only average in general intelligence, there will be certain fields, such as engineering, that will probably be closed to him. On the other hand, there may be nothing in the result to indicate whether he should become a mechanic, an electrician, or a radio repair man, or whether he should enter any one of a number of other fields of work. Students should emulate the conservatism of our best psychologists. These men are extremely cautious in interpreting the results of tests. In every case the student will need to balance his test results with his own interests and with his own estimation of the probable vocational openings ahead.

Need for More Effective Guidance. With the problem as complex as we have shown it to be, there is little wonder that we find today so many "square pegs in round holes." No one can estimate the percentage of people who are forced to work in occupations in which they are not happy and in which they are producing less efficiently than they could in some other field. The two-fold penalty for ineffective vocational guidance is a group of personal maladjustments, which frequently become acute, and secondly a tremendous economic loss. Proper vocational guidance will never be able to eliminate these two factors entirely, but it certainly can do much to reduce them. As far as the individual student is concerned, he should take the realistic point of view that while vocational guidance cannot tell him

in absolute terms just what he must do, it can nevertheless greatly improve his chances of fitting into an occupation in which he will be both happy and successful.

Vocational Opportunities. No general treatment of the problem of vocational opportunities is possible. These opportunities will change not only from month to month but from locality to locality. Certain books such as Pitkin's *Careers for Youth* attempt to evaluate the future of several vocations. There is probably much of value in such an attempt, but the reader should always remember that the situation may change drastically within a few months from the time such a book is written. Perhaps a more conservative approach to the problem of vocational opportunities will result not only from an analysis of the probable money to be obtained but also from an investigation of the psychological factors in the form of manner of living and social and intellectual contacts that may be expected to accompany a given line of work. Some educational psychologists are going so far today as to reemphasize the importance of general cultural and scientific training. They believe that technological processes are changing so rapidly that it scarcely pays to spend large amounts of time in training for jobs that may become nonexistent next year through the invention of some new machine. This pessimistic view is probably justified in a measure as related to such things as factory methods or even office procedures. It is not so likely to be true of professional lines of work or even scientific agriculture where the foundation training will almost

certainly be the starting point for going on to the mastery of whatever new processes develop.

Money Is Not Everything. Too much of our consideration of vocational opportunities has, perhaps, centered around the question of the probable salaries to be obtained. More attention needs to be given to the values not measurable in dollars and cents. If present tendencies toward the stabilization of our present economic chaos continue, it is not improbable that the future will bring a reduction in emphasis upon money in the sense that all useful lines of work will bring their own adequate compensation. We may even hope for a day in which every useful line of work will bring sufficient compensation so that the worker will no longer need to be concerned as to the essentials for his material welfare. If such a day does come, those persons who have utilized their psychological knowledge in determining the intellectual, social, and personal values related to their occupations will find themselves infinitely better off than those who planned only in terms of money.

Educational Guidance

A phase of educational work which is all too commonly neglected and the fulfillment of which has been one of the important aims of the present course is that of providing educational guidance. Educational guidance cannot be entirely separated from vocational guidance in the sense that adequate education will include education for a vocation. Dr. W. H. Snyder, one of the outstanding leaders in the field of junior-

college education, has stressed the twofold function of education as being the development of vision and skill. By vision he means the development of cultural background that makes for successful living. By skill he refers to vocational training. In the past these two functions of education have tended to be separated. The classical high school has stressed the development of vision unduly, and liberal arts colleges have been devoted almost exclusively to it. Trade schools, on the other hand, have devoted themselves largely to the development of skills, thus turning out young men and women who were perhaps fitted to hold down a job but who were wanting in those cultural values that make for successful living.

Educational guidance involves the problem of equating these two larger objectives of education. It is probably true that in some technical courses it may be difficult to find time for the development of general subjects. The more common error that college students make, however, is that of following the general subjects to the exclusion of any of the semiprofessional curricula. Students should be acutely aware of the fact that for most of them the college period represents their last opportunity to prepare themselves for a definite line of work. The guidance functions, which are performed by the various administrative offices and which the present course is attempting to supplement, should aid the student in deciding which cultural subjects are most important for his intellectual welfare and which skilled subjects are most likely to fit in with his native abilities and his basic interests.

Summarizing Your Personal Inventory

With the completion of the study of your vocational interests the psychological analysis of your traits and abilities has been completed. It remains for you now to assemble this group of data so as to arrive at some final conclusions regarding future action. The following tests are envisaged as entering into this complete picture.

1. A study-habits inventory
2. A survey of your high-school achievement
3. An analysis of your personal adjustment problems
4. An inventory measuring your basic social values
5. A measure of general intelligence
6. A measure of your mechanical aptitudes
7. A measure of your reading ability
8. A measure of your vocational interests

It may be that you have not had the opportunity to use all these eight measures, or it may be that some other measures have been substituted for certain of them. In any case your immediate task should be to assemble all the scores that you have available and to put these in the form of a carefully prepared psychogram. You will notice that most of the tests break up into subheads. In some cases a study of the scores on these subheads is of greater significance than the total score on the trait.

In evaluating the final results of your personality survey you will do well to bear in mind the three basic problems that are being dealt with. These are: (1) your study techniques and other problems relating to your immediate college life, (2) problems relating to your per-

sonality, including consideration of possible maladjustments and ways in which your personality can be made more pleasing and effective, and (3) an attempt to measure your basic abilities so as to provide you with a basis for more intelligent selection of your lifework. Every effort has been made to point out to you the limitations of the tests as well as the manner in which they can help you. The objective of adjustment and self-orientation will be accomplished best by giving the student an understanding of his own situation and some knowledge of the psychological approach to his problems. Every student should feel free to come to his instructor for personal conferences, whenever he encounters difficulty in interpreting his own test results or in trying to plan a course of action based upon them.

Planning for Happiness

We may conclude our discussion of life planning with a few practical suggestions of a general nature. The first of these would be to remind the student of the importance of capitalizing on his strong points. It would seem unnecessary to urge persons to use their strong points instead of wasting energy trying to bring weak points up to par. Nevertheless, this latter is exactly what a great many students and adults alike do. If our weak points can be readily improved, we shall certainly want to do so, but to waste one's energies in worry or fruitless efforts based on our weak points certainly is very poor psychology.

Leisure. We read a great deal today about the coming leisure and the problem of its correct use. There is,

perhaps, little question that leisure time will increase in the future. By leisure time most people mean time not spent at the task by which they gain a livelihood. People who derive most in the way of rich living have probably always been those who found much in the way of interesting activity outside their daily work or those more fortunate ones whose work was itself so varied and interesting as to provide the equivalent of leisure-time activity. Self-development through proper use of leisure time is no more mysterious than any other psychological process. Self-development means the development of new activities. To be of the highest type, these new activities must be of such a nature as to place demands upon the individual. Hobbies that are so simple and puerile as to call for almost no creative effort on the part of the hobby followers are no more valuable to a person than going to movies. The great value of leisure activities lies in the fact that in them one can express those interests that are denied in one's workaday life. The value of such expression of interest is particularly great in those cases where one's bread-and-butter job does not express one's most fundamental interests. Many of us will find it necessary to follow occupations that are uninspiring at least in part. We can do this and still live rich personal lives through the proper utilization of our leisure.

The Great American Delusion. Americans have long been accused of being "go-getters." There is, perhaps, much to the belief that we have been oversold on the "success" idea. Many cases of severe personal mal-

adjustments are traceable directly to the fact that young people have had impossible goals set up for them. Many times they have striven valiantly to achieve goals which in the nature of events they could not possibly reach. When they are finally forced to recognize their failure, a serious readjustment problem presents itself. How much better off we should be if we could accept a more reasonable philosophy of life. Such a philosophy, which may be called "the philosophy of contentment," means a recognition on our part that life can be very much worth while even though we as individuals do not reach some ultimate pinnacle of fame. The philosophy of contentment need by no means be the same as a philosophy of mediocrity.

It is particularly true in what we call the present machine age that we need to devote more of our attention to the enrichment of our personalities than we have in the past. As we learn to perfect more and more completely the machines of our machine age, they will come in turn to care automatically for our material needs. As this occurs, the importance of success as an achievement in material things will become less and less important. At the same time, however, the mechanization of certain aspects of our lives that is involved in this process will throw an increased burden upon our resources relative to the development of our personal lives. We shall come to see that a major goal of life in a machine age must be the development of rich personalities through continued learning rather than the achievement of material goals.

SUGGESTED READINGS

BINGHAM, W.: *Aptitudes and Aptitude Testing.*
CHASE, S.: *Men and Machines.*
GRAY, J. S.: *Psychology in Use*, Chap. 4.
LANGTON-DAVIES, J.: *A Short History of the Future.*
MORGAN, J. J. B.: *Keeping a Sound Mind.*
RUSSELL, B.: *Scientific Outlook.*
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Chapter 13

KNOWING YOUR WORLD

Nature of Sensations

A SENSE organ is a structure specialized to respond to one class of environmental change. Energy changes of many sorts are going on about every individual. Only certain of these changes may be significant. Sense organs are structures that have been developed to respond to those changes that are most significant for the welfare of the organism. Sensory receptors are selective in function, *i.e.*, they respond only to certain of the energy changes going on around them.

The adequate stimuli for any sense organ are those energy changes to which the sense organ typically or commonly responds. Inadequate stimuli are other forms of energy change which may cause the sense organ to respond, but for which the sense organ was not designed.

Exercise: A slight pressure upon the eyeball may result in flashes of light. Here the cones are responding to the inadequate stimulus of pressure.

It is clear that not all the energy changes in the environment can be reacted to by the sense organs. Sound waves, light waves, pressure, actual substances in the air, and a few other types of changes each may impinge upon an appropriate sense organ: but many other types of change that have been shown to exist

by physical apparatus do not affect the organism because no structures have been specialized for them. Examples of these are radio waves and the ultraviolet waves of the sun. The latter may do much damage to body tissues without arousing a sensory response in us.

Exercise: When we are sunburned, we are obviously being influenced by environmental changes around us. Are these changes adequate or inadequate stimuli for any sense organ? List five examples of "inadequate" stimuli.

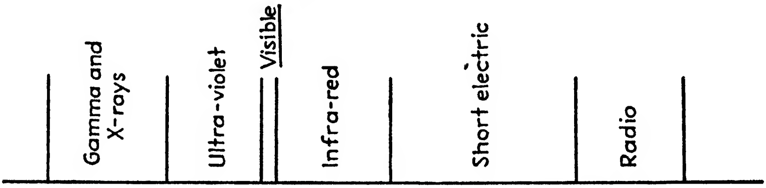
Not only are sense organs specialized to receive only certain classes of changes, but most of them receive even these best within a narrow range of intensity. Thus the ear responds to sound waves only within a given range of frequency. The same is true of light. There are undoubtedly chemical substances in the air which we never perceive because we lack appropriate specialized receptors in the olfactory sense organ.

Exercise: Recent experiments with ultrasonic waves have shown that milk can be "pasteurized" by bombarding it with sound waves of a frequency far above that to which the ear can respond. Would these energy changes be either adequate or inadequate stimuli for the ear? List five kinds of energy change to which the human cannot respond directly.

In addition to "ultra sonics," other experimentors have shown that sound waves of high frequency, but not above the auditory range, may also be fatal to certain microorganisms. Kreuger has used sound waves of a frequency of 9,300 cycles to destroy bacteria and viruses. He was able to destroy the bacteria that caused

boils and carbuncles by subjecting them to this penetrating sound.

That visible light rays cover only a very small portion of the total span of energy disturbances in the ether is shown in Fig. 36. It will be seen from this chart that radio waves, heat waves, and even cosmic rays all are but different wave lengths of the disturbances in the ether which at certain frequencies constitute visible colors. It may be noted also that ether waves, which are somewhat longer than light waves, constitute inade-



Only a small fraction of the complete spectrum is visible to the human eye

FIG 36.

quate stimuli for vision but are still capable of having very profound effects on our bodies in the form of sunburn. We see from such considerations that the functions of each of the various sense organs are not to inform us of all parts of the universe about us but merely to cover those phases of energy changes that are most likely to be important for our lives and continued adjustments.

Two problems grow out of these considerations. First: how many senses are there? It will soon become clear that the old statement of the five senses is inaccurate, for we shall see that the sense of touch alone is made up of four different types of functions. Senses, as popu-

larly used, can mean nothing more than specialized sense organs such as the eye, ear, tongue, etc.

A more important question is that of the number of sense qualities which may be experienced by an organism. As we proceed with the discussion, it will become increasingly apparent that the number of sense qualities depends upon the degree of refinement of the sensory structures. An elementary sensory quality is one that cannot be reduced to simpler sensory experiences.

Phenomena of Adaptation

The biological function of sensory apparatus is that of reporting changes in the environment, the reason for this being that changes in the environment will frequently require action on the part of the organism to bring about adjustment to the new situation. Most sense organs cease to respond to a given stimulus situation when it has existed for a certain length of time. They will, however, immediately respond if any further change occurs. From this, we arrive at the principle that the primary function of sense organs is to report changes from the *status quo.*

Sensations are not isolated mental events. From what has been said, it should be clear that sensations are not isolated functions or the mere taking in of sensory changes. The biological function of every sensation is to originate motor responses. For this reason, it is important that the several senses work cooperatively. Sense organs not only work with each other, but their functions always constitute a part of a total reaction picture. Psychologists have given the name perception

to the total process of receiving and responding to a given stimulus situation.

Psychological interest in sensation tends to center in the nature of sense-organ function and in the measurement of the acuity of sensory functions. The latter problem is of obvious importance. The tremendous losses in personal efficiency resulting from poor eyesight are known to all; likewise, the personal discomfort and inefficiency resulting from deafness are familiar. These two senses offer, perhaps, the most strikingly practical field in which sensory acuity operates. There are, however, wide individual differences in the sensory acuity of the various other sense organs.

How May We Determine Sensory Acuity? Our answer comes from a reconsideration of the function of sense organs. The purpose of sensation is to originate action. The criterion then of sensory acuity is that of ability to react. If an organism can react in a differential manner to two stimuli, it can be said that it has sensory acuity to that degree.

Watson and other comparative psychologists were among the first to make use of this technique. In the case of lower animals, one cannot, of course, ask the animal if he senses a given quality. What one can do is to determine whether or not the animal can learn to respond to one stimulus in one way and to another in another way. Thus, if an animal can learn to enter a passageway leading toward food when a red light is burning and to avoid the same passageway when a green light is burning over it, one may be assured that the animal has red and green discrimination, provided,

of course, that other factors such as intensity are kept constant.

Pavlov has also utilized the conditioned-reflex method in determining sensory acuity. Thus, he conditioned dogs to respond positively to one tone and negatively to a slightly higher tone. He then progressively reduced the difference in the number of vibrations between the tones until the animal could no longer distinguish between the two. He was able to show that a dog could differentiate between a difference of as little as 12 vibrations a second. Actually this is the same method that is used in the study of sensory acuity in humans. Thus, in the visual acuity test, the subject is asked to read the letters on the test chart. If he can react correctly, *i.e.*, pronounce the correct letters, it is assumed that he has vision of that quality.

The Seashore music test measures auditory acuity in the same way. A subject is asked to respond to a pair of tones by stating whether the second is higher or lower than the first. His auditory acuity for pitch is thus determined in terms of the percentage of correct reactions. All sensory functions can be studied in terms of ability to react differentially.

Sense of Taste

The adequate stimuli for taste consist of chemicals in solution. The receptors for taste are the taste buds, which are found in folds in the little hills or papillae on the surface of the tongue. A few taste buds may also be found in other parts of the mouth.

The sense of taste has been reduced to four elementary sense qualities. These are: *bitter, sweet, sour, and salt.* They are somewhat specialized as to location, bitter being most acute at the rear of the tongue, sweet at the front of the tongue, sour around the sides of the tongue, and salt at the tip and sides.

The phenomenon of adaptation is clearly observable in the sense of taste. Adaptation refers to the fact that successive stimulations of a given sort produce less and less keen sensitivity. Every person knows that after a few pieces of candy have been eaten, additional pieces lose much of their sweetness. The same is true of the other taste qualities. Another phenomenon that is found in taste is that of contrast. In contrast we find that stimulation of one sense quality accentuates the reaction of another sense, which may be stimulated at the same time or shortly after. Lemon tastes much sourer than it normally would when taken immediately after some candy. The fact of contrast is frequently used voluntarily, as in the case of lemonade in which we mix both sweet and sour so as to accentuate both, and at the same time have the agreeable experience of a sensory blend. This leads us to notice that in the case of taste, as well as other senses, many of the sensory qualities result from the stimulation of blends of elementary qualities rather than from the stimulation of separate qualities alone.

Sense of Smell

The adequate stimulus for the sense of smell consists of particles of a substance in gaseous form. The particles

are carried by the gaseous medium into the nasal cavity to its uppermost part, where they fall upon the surface of the olfactory sense organ. The olfactory area is separated from the olfactory tract leading to the brain by the floor of the skull. Thus the nerves forming the olfactory receptors merely pass through the floor of the skull and into the brain via the olfactory tract. Before these particles can act chemically upon the receptors for smell, they must, as in the case of taste stimuli, enter into a liquid solution. This is achieved by means of the fact that the olfactory receptor secretes a mucous substance.

The elementary classifications or reference qualities of smell are listed by Henning as follows: fruity, flowery, spicy, resinous, smoky, putrid. It is held by most psychologists that all the possible olfactory sensations may be described as showing varying degrees of resemblance to a pure fruity, pure flowery, etc., odor.

The last of the elementary classes of smell, *viz.*, putrid, is of unusual interest to the psychologist in that it demonstrates so well the place the sense of smell holds in safeguarding our bodies. Fruity, flowery, and spicy smells may guide us to digestively desirable materials, but the sense of putrid operates as a definite warning against taking poisonous materials into our stomachs. Of all the foods used by human beings, proteins are the form most difficult to preserve and, when spoiled, are most likely to generate deadly protein poisons. Psychologically, the odor putrid is defined as that resulting from decomposed protein material. Decayed fish and cheese are among the best examples of this. Once such

material has been taken into the stomach, the surest way of protecting the body remains that of emptying the stomach through vomiting. Indeed, this is so important that the odor putrid has come to operate as a natural stimulus for this reaction. The social psychological implications of this situation are most interesting. Vomiting is, of course, considered a repugnant act, and yet, its importance is such that we make references to it almost daily in talking about persons or situations we do not like. How often do we comment that there is something "fishy" about an idea, or that the idea "smells." In the same way, when we say that a person or situation "makes me sick," we refer actually to this particular kind of sickness resulting from the smell putrid.

We are all much more keenly and pleasantly aware of the social uses of terms growing out of our basic reactions to flowery and fruity odors. These odors, as represented especially in perfumes, appear frequently in literature and poetry to symbolize ideal and romantic situations. These carry-overs from the sense of smell into social usage are so important that one is really surprised that so little in the way of psychological studies has been made of them.

One of the most important points with relation to taste and smell is the fact of the interaction between these two senses. It is known to every child that if the nose be stopped so that the sense of smell cannot operate, one usually cannot tell the difference between a bit of raw potato and a bit of raw apple placed upon the tongue. This is because the essential difference between

the two is one of smell and not of taste. Many sensations that we commonly call taste are actually blends of taste with other senses, such as touch, smell, or temperature sensations. Our preference for a crisp, crunchy apple rather than for a mellow, smooth apple may depend in a large part upon its tactual qualities or even upon its auditory qualities in the sense that we like to hear the crunching of the apple.

Exercise: An interesting illustration of the interrelationships of these qualities is found in the case of carbonated beverages. We all recognize that carbonated water adds a peculiar tang or zest that constitutes much of the pleasure of a beverage.

Carbonated water is ordinary water in which carbon dioxide has been dissolved under pressure. When the pressure is removed, the bubbles of carbon dioxide rise to the surface. When this process continues in the mouth, the bursting of the little bubbles of carbon dioxide constitute an actual tickling of the inside of the mouth. Thus in a certain sense it is possible to say that the "tang" of a carbonated beverage is a touch sensation in the inside of the mouth and not a taste sense as such at all.

Exercise: List all the sense qualities that enter into the "taste" of (1) an apple, (2) a steak.

Skin Sensations

Four primary qualities of skin sensation are usually named. They are: warm, cool, pain, and pressure. Exploration of the surface of the skin with a blunted

pin will show that each of these qualities is related to definite points on the skin's surface.

The quality "hot" is not, as one might expect, merely intense "warm." Hot is a blended sensation resulting from the simultaneous stimulation of warm and cool receptors. The explanation of this lies in the phenomenon called "paradoxical cold." Cold receptors respond not only to cold temperatures but also to high temperatures (over 45°C.). When cold receptors are

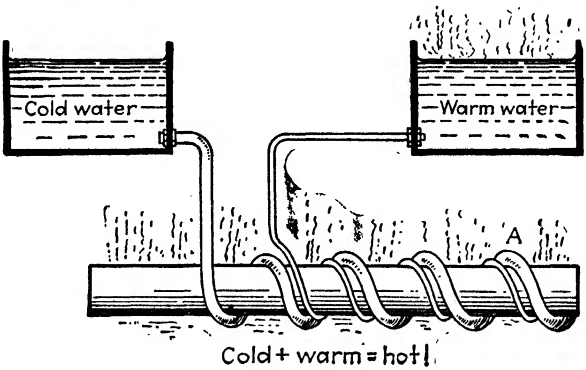


FIG. 37.

thus aroused by hot stimuli they give rise to sensations of cold. Now if a hot surface is contacted, both these paradoxical cold sensations and the regular warm receptors will be aroused. The blend of these two qualities gives the sensation of hot. An apparatus by means of which we can prove this situation is shown in Fig. 37. If we hold the tube *A* in our hand, we know the hand is being stimulated by the alternate temperatures of warm and cold. Yet the tube feels definitely *hot* to the hand!

Extremes of temperature sensations frequently seem much alike. Thus we speak of being "burned" by Dry

Ice, whereas actually freezing would be more appropriate. The reason for this confusion lies in the fact that extremes of temperature arouse pain stimuli as well as the usual receptors. Thus extreme cold (below $-10°$C.) involves both cold and pain sensations. Extreme heat (above $+50°$C.) involves warm, cold, and pain sensations. The greater the extremes of temperature the greater the predominance of the pain element. Pain is always qualitatively the same wherever found so that, as it becomes the dominant element, we tend to confuse extreme hot and cold.

Cold, warm, and pressure sensations all show the phenomenon of adaptation. Pain, which is discussed in more detail elsewhere, does not.

Sense of Hearing

The adequate stimuli for hearing consist in air waves ranging from about 25 vibrations per second to 25,000 vibrations per second. Every vibrating surface tends to set up these alternate conditions of condensation and rarefaction in the air. The patterns of air waves set up may be infinitely complex, and, as we have already seen, only a small part of them are capable of being received by the human ear.

Noises and Tones. Auditory sensations may be classified under two headings: noises and tones. Noises result from nonrepetitive sound waves. In other words when the wave patterns become so complicated and so intermixed that there is no observable continuity of the pattern, we call the sensation a noise. Tones, on the other hand, consist in wave patterns that are repeti-

tive. Tonal patterns may be very complex, but there will always be observable certain wave forms that repeat themselves over and over.

Timbre or purity refers to the complexity of the pattern of secondary waves which is imposed upon the fundamental wave frequency. When the pattern of these "overtones" becomes great enough they may actually mask the fundamental wave. When this happens the tone ceases to be distinguishable as a tone, and we may respond to the whole complex structure as noise. This explains why some modern music with its complicated patterns of overtones sounds to many of us more like a boiler factory than like an orchestra. As a matter of fact, it must be confessed that even classical music is difficult to follow and appreciate if one does not have the musical ear and training to detect the underlying tonal patterns.

Three Attributes of Sound. Air waves may vary in three particulars: (1) Pitch refers to the frequency of the waves and is measured in terms of the distance from crest to crest. (2) Intensity refers to the amplitude of the sound waves and is measured in terms of the height of the wave. (3) Timbre or purity of a wave refers to the presence or absence of an accessory wave imposed upon the fundamental wave. All the complicated phenomena of hearing result from the action of these three variables.

Structure of the Ear. The accessory apparatus of the ear is, perhaps, the most complicated of any of the sense organs. The energy brought to the ear by the air waves changes its form no less than four or five times. The various forms of deafness which will be discussed

later may be associated each with one of the many mechanical phases of hearing.

The outer ear consists of the shell or visible portion of the ear, which in many animals functions as a trumpet to direct the sound into the meatus, a tube about an inch in length leading to the eardrum. The eardrum or tympanic membrane provides a complete stoppage of the meatus and makes the division between the outer and middle ear. The middle ear contains the ossicles or the three little bones, the hammer, anvil, and stirrup, which transmit the vibrations of the eardrum across the cavity of the middle ear to the oval window leading to the inner ear. The last of the bones, the stirrup vibrates against the membrane covering the oval window and, as it vibrates, agitates the perilymph liquid in the inner ear. The ossicles are held snugly articulated by means of a tiny muscle stretching up from the Eustachian tube. This muscle, the tensor tympani, connects to the anvil by means of a tendon and through changes in its tonus prevents any loss in the transmission of sound through slackness in the bony system. The relationship of the tensor tympani muscle to one common form of deafness will be discussed later in connection with the work by Dr. Crowe.

The inner ear consists of a very complicated labyrinth hollowed out of the bony structure of the skull. This labyrinth is, in fact, a chamber within a chamber. The outer chamber is filled with liquid called the "perilymph." Within this lies a structure called the "membranous labyrinth." It may help to visualize this inner chamber as being similar to the inner tube of a

tire. This inner tube, which is filled with endolymph, partly floats in the perilymph and is sensitive to vibrations occurring in it. This inner structure contains the organ of Corti, which is the sense organ for hearing proper and, in conjunction with the semicircular canals, contains the nerve cells for the sense of balance.

The cochlea is the part of the inner ear related to hearing. The movement of the stirrup sets up the vibrations in the perilymph as has already been stated. These vibrations pass upward along the ascending canal, loop around the end of the cochlear duct, and pass back down the descending canal to its end at the round window. During this passage the vibrations of the perilymph set up sympathetic vibrations in the endolymph of the cochlear duct. These in turn set up vibrations of the organ of Corti in which are embedded the hair cells, which are the true auditory receptors. Impulses set up by the hair cells are conveyed back through the auditory nerve to the auditory area of the brain.

Theories of Hearing. Just how the vibration of the organ of Corti at its different points and the resulting stimulation of the cells of hearing result in the reception of sound has never been determined. Many theories have been advanced, the best known being perhaps the piano theory of Helmholtz. This theory considers that since the cochlear structure becomes progressively smaller and since therefore the basilar membrane that divides it becomes progressively shorter, hearing can be explained on the principle of sympathetic vibration. If one sings into the open front of a piano, one will find that the long strings will vibrate sympathetically with

low tones, whereas the short strings will vibrate with the higher tones. The piano theory of hearing is based on the same idea. Slow vibrations in the liquid of the cochlea result in the vibration and hence stimulation of the nerves in the longest part of the basilar membrane. The higher notes result in the sympathetic vibration of the membrane at the points where it is shorter and hence arouses a response on the part of the auditory nerve cells located there.

A second theory is the telephone theory. When we speak into a telephone, our voice is transmitted in terms of electrical impulses flowing over the wire. According to such a theory, the pitch of a tone must be correlated with the frequency of electrical waves in the wire. Intensity must be correlated with the amount of current released through each vibration wave. This theory represents some difficulty, since recent work on nerve function in connection with the all-or-none principle leads us to suspect that intensity in nerve action is achieved by means of the frequency of the impulses passing over the nerve, which, according to this theory, should be the factor that controls pitch.

Out of this problem has grown a third theory called the "wave-pattern" theory. The interest here centers about the problem of whether frequency of wave impulse determines pitch or whether it determines intensity. It is believed that we have here a twin function, in other words that each individual nerve fiber does not carry a certain auditory quality but rather auditory quality results from the cooperative function of many nerve fibers. For example, it is known

that no single nerve fiber can transmit impulses faster than 1,000 per second. On the other hand, we know that some auditory frequencies reach the rate of 30,000 to 40,000 per second. Such a tremendous frequency could be transmitted by the cooperative action of many nerve fibers if each of them responded at its maximum rate, provided they responded out of phase with each other. Thus, if the rate to be transmitted were 2,000 per second, fiber *A* would respond to the first vibration, fiber *B* would respond to the second vibration, and $1/2000$ second later fiber *A* would respond to the third vibration, etc., so that the two operating together would deliver to the distant point in the brain the 2,000 vibrations per second in the same ratio at which they appeared in the ear.

Intensity might possibly be explained in a similar fashion. A sound of a given pitch of low intensity might be transmitted by a relatively small number of fibers, whereas sounds of the same pitch but of greater intensity might involve many more fibers all working in the same general fashion. None of these theories has achieved complete acceptance. Psychologists are always on the alert for new methods of experimental investigation which may help us to understand these phenomena. The famous experiments performed by Wever and Bray, although not proving the correctness of the wave-pattern theory, nevertheless show definitely that the auditory nerve does transmit an energy pattern that corresponds exactly to the energy pattern of the air waves that come to the ear. This in itself is of tremendous significance, because it shows us that hearing is

not what might be called a symbolic response, *i.e.*, it is not a matter of interpreting a unique type of nerve stimulus to mean a totally different type of air pattern. It therefore opens up the way for a direct attack upon the nature of hearing.

Wever and Bray's Experiment on Auditory Nerve Currents. Like most great experimental achievements, the Wever and Bray experiment is simplicity itself. It consists of exposing, by means of a surgical operation, a part of the auditory area of a cat's brain. In order to perform this experiment the cat was deeply anesthetized, and after a part of the brain had been exposed, platinum electrodes were attached or placed upon this part of the brain. Now it has long been known that nervous activity results in the release of electrical energy called "action currents." This energy may be picked up by means of electrodes and may be amplified. This is exactly what Wever and Bray did. They attached these electrodes to wires leading to a powerful audio-amplifier, a device, based on the radio principle, that builds up faint electrical currents to a point where they can operate a loud-speaker. Next the cat was placed in a soundproof room with only the wires leading out to the audio-amplifying set. Then a phonograph in the soundproof room was started. The amplifying set was turned on, and, to the amazement of the onlookers, it was found that the loud speaker played back to the audience exactly the music that was being played in the soundproof room. In other words, the air waves produced by the phonograph fell upon the cat's ear, caused the membrane to vibrate, moved the bones of the middle

ear, agitated in a complex manner the auditory nerve cells in the cochlea; these sent out a pattern of nerve energy which corresponded exactly to the air patterns from the phonograph. These nervous impulses were carried to the brain where they were taken up by the electrodes, transmitted along the wire to the amplifier, and then played back in the form of sound waves exactly the same as those produced by the original phonograph.

Further information regarding the present problem will undoubtedly come in the future when the experimental technique shall have advanced to such a point that it will be possible to isolate individual fibers of the auditory nerve in order to determine the role that each fiber plays in the transmission of sound. This tremendously difficult feat is being made the subject of active experimentation and may perhaps finally lead to the solving of the mystery of the nature of hearing.

In the meantime the science of sound has advanced with great strides from the standpoint of the practical applications. The study of sound as a sensory quality presupposes an understanding of its characteristics from a physical standpoint. These characteristics have been learned through study by both psychological and physical methods.

What We Hear. The nature of sound is clearly shown by a remarkable device invented by Professor Miller called the "phonodeik," a diagram of which appears in Fig. 38. Voice or other sounds are first directed against the diaphragm *D*. This diaphragm is not unlike the diaphragm of a phonograph reproducer. It is usually made of mica or preferably of a very thin piece of glass,

often only $^{3}/_{1000}$ inch thick. To the center of this diaphragm is attached a very delicate silk thread. This thread is wrapped around a tiny pulley and thence is attached to a small coil spring. The pulley is attached to a shaft set in jeweled bearings similar to those of a high-grade watch. On this shaft is also attached a tiny mirror *M* $^{4}/_{100}$ inch square. When the sound waves fall upon the diaphragm *D*, it vibrates back and forth in accordance with the pattern of the air waves. This movement is transmitted by the delicate thread to the pulley arrangement, which in turn causes the tiny mirror to rotate back and forth on the jeweled bearings. The extent and rate and pattern of this rotation are in exact keeping with the differences in the sound pattern. In order to observe this vibration and also to make permanent records of it, a source of light from *F* is directed against the mirror. This light will be reflected by the mirror to a screen at some distance, such as *L*. The farther away the screen is, the greater will be the magnifications of the movements of the mirror. In this way a very large wave pattern may be obtained in which the waves may have an amplitude of from a few inches to a foot or more and may thus be observed by a large auditorium full of people.

This type of apparatus is very useful in illustrating the facts of sound to an audience. In carrying on research work in sound, it is necessary to have permanent records of the sound waves. This is easily obtained by directing the light, which passes the lens, against a wheel some 2 feet in diameter around which has been attached a strip of motion-picture film. This wheel is

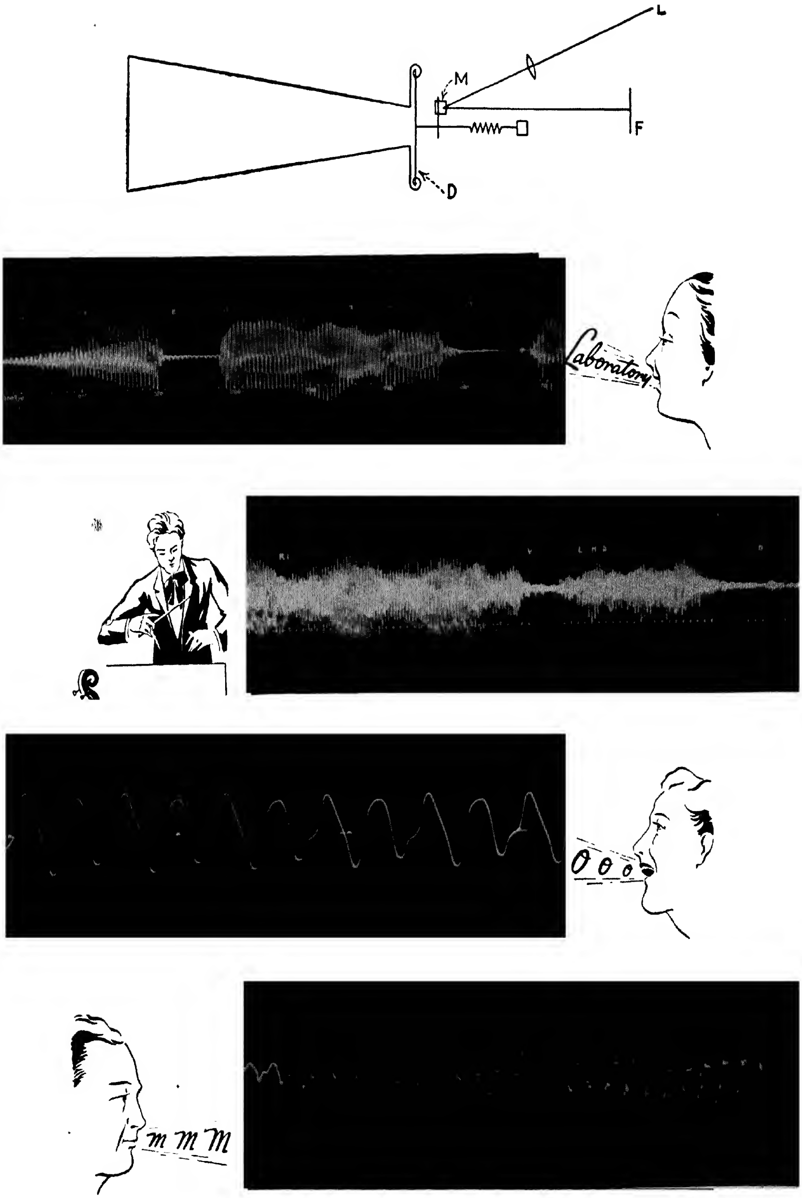


FIG. 38.—*Phonodeik and sound waves produced by it. (From Miller, Sound Waves, The Macmillan Company.)*

(Facing p. 350)

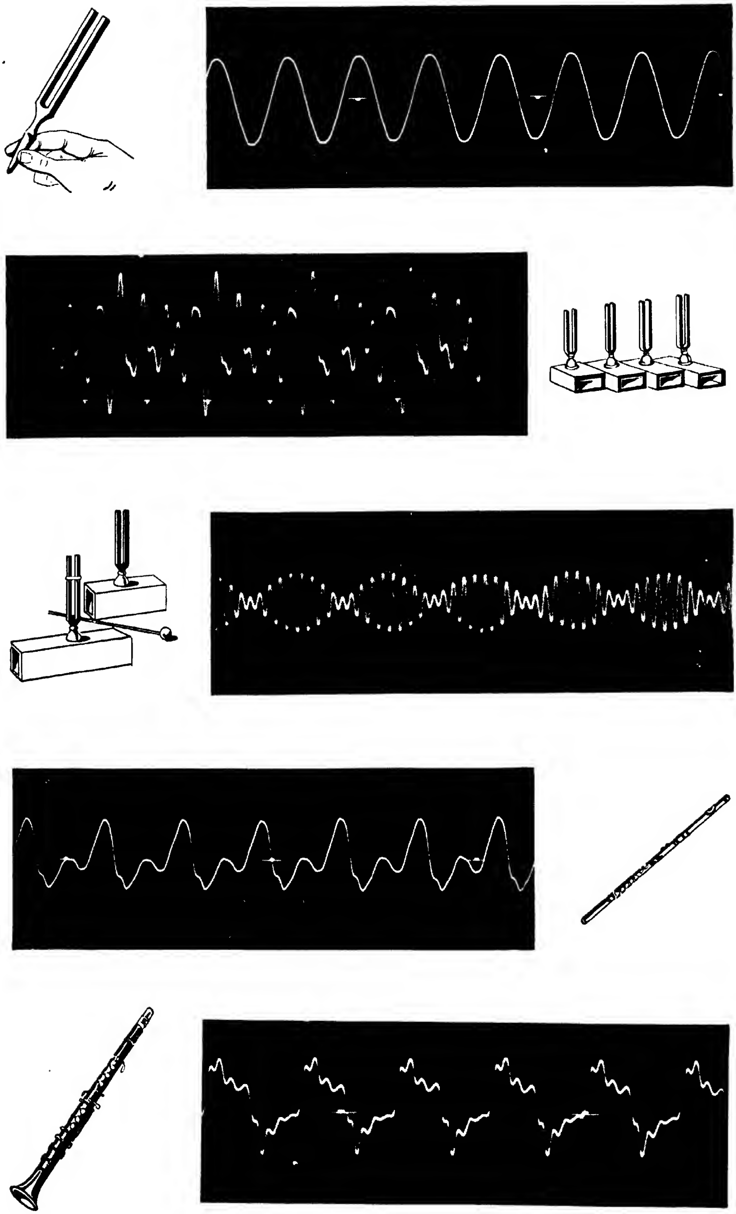


FIG. 38 (*Cont.*).—*Pure tone, fundamental and overtones, beats and notes from flute and clarinet.*

(*Facing p.* 351)

revolved so that, as in the case of the phonodeik, the points of light will expose the part of the film that they strike and leave a line. When the phonodeik is spoken into, the dot of light will move up and down and will leave a photographic tracing on the moving film in exactly the same way that our tuning fork left a tracing upon the smoked paper. These strips of film are then developed and provide a permanent picture of the sound waves.

The sounds that are to be studied in this way may be obtained from a variety of sources. Easiest of all is the voice of the experimenter who speaks into the phonodeik. The difficulty here is, of course, that it may not be possible to repeat this sound exactly. For this reason, it is usual to study voices that have been recorded on phonograph records. In the first place the same record may be photographed again and again with the knowledge that the source of sound will always be the same, and in the second place it is possible to obtain phonograph records of the voices of famous singers and speakers. In this way great progress has been made in determining those qualities that make for voice excellence.

Practical Uses of Sound Study

Practical applications of the knowledge of the nature of sound include the phonograph. If we could examine the phonograph record under strong magnification, we would see that the apparently straight lines that make up the grooves of the record are actually not straight at all but are wavy lines not unlike those we have seen

to be photographed on the motion-picture film. The phonograph is nothing more or less than the permanent recording of waves in wax, corresponding to the air waves, just as the phonodeik permits the recording of light waves, corresponding to the sound waves.

A more recent application of this same principle is found in modern talking pictures. These are of two kinds. In the first we have a direct use of the phonograph principle in connection with the ordinary motion-picture projector. The dialogue is recorded on huge phonograph records, which are placed in a machine that revolves them in careful synchronization with the movement of the film through the projector. The phonograph record is located in the projection booth in the back of the theater. An electric reproduction system is used so that the reproducer plays into a strong audio-amplifier, similar to that used in the Wever-Bray experiments. From the amplifiers, wires lead up to the front of the theater and are attached to loud-speakers located directly behind the screen.

The projection of talking pictures offers an interesting example of an auditory and visual illusion. We all know, of course, that the sound in the talkies does not come from the mouths of the speakers on the screen but, rather, that the voices of all the different speakers come from the same place, *viz.*, a loud speaker located behind the screen. Nevertheless, we have no difficulty in associating a given sound with the speaker of the moving mouth of the appropriate actor.

The second method of making talking pictures, and the one now more commonly used, is based upon the

photographing of sound waves upon the same film as that used for the pictures of the actors. In this case the "sound track," as it is called, is identical with the sound patterns that we have seen photographed upon the film by the phonodeik technique. The difference is, of course, that the sound track is very, very small, corresponding more nearly to the lines of the phonograph record.

Crowe's Work on the Causes of Deafness

The technique for studying auditory action currents which has been developed by Wever and Bray opens a wide field for practical studies relative to hearing. Dr. S. J. Crowe of the Johns Hopkins School of Medicine has carried out such research in an attempt to isolate some of the underlying causes of deafness.

Dr. Crowe points out that there are two points of attack in searching for these causes. The first relates to the function of the middle and inner ear, the second relates to the functions of the central auditory pathways. In the research carried out to date, he has concentrated his efforts on the study of the middle and inner ear.

The first step in the study was to determine age differences in auditory acuity. This was done by means of audiometer tests, followed in some cases by post-mortem examinations of the ear structures. As a result of an analysis of 353 subjects ranging in age from twenty to seventy years, Dr. Crowe learned that the lower tones, those below 1,024 vibrations per second, were heard equally well by all ages but that auditory acuity for the higher ranges is markedly impaired in each

successive age group. An illustration of this interesting fact is to be found in the upper limits of hearings for respective groups. The upper limit for subjects between twenty and forty years was 16,384 vibrations per second, 10,321 vibrations per second for subjects between forty and sixty years, whereas the upper limits for the group of sixty years was only 8,192 vibrations per second.

In order to determine whether or not this progressive loss in acuity for high tones was related to systemic disorder, 468 patients suffering from one or more of five diseases were examined. The diseases considered were arteriosclerosis, syphilis, hypertension, chronic cardiovascular renal disease, and malignant growths in various parts of the body. As a result of this study, it was learned that no one of the diseases was the cause of impaired hearing in advanced age.

The next problem was then to attempt to discover the underlying cause of this difficulty. It is a matter of common opinion that deafness is intimately related to a defect or a breaking of the eardrum or tympanic membrane. In order to test out this popular notion, Dr. Crowe reproduced the Wever and Bray experiment on cats in which the eardrum had suffered both simple and multiple incisions. It will be remembered that the auditory action currents follow faithfully the tones sounded into the ear. It is possible to measure the fidelity with which the ear functions in terms of whether or not the frequency produced by the nerve corresponds exactly with the frequency of a fixed tone sounded in the ear. The surprising result of this preliminary study was

that even multiple incisions of the eardrum have practically no effect on sound transmission.

Attention was next turned to the function of the ossicles, or the three bones of the middle ear, together with the tensor tympanic muscle. This muscle, which lies along the upper portion of the Eustachian tube, connects by means of a tendon with the hammer bone. Its function is to keep the ossicles snugly articulated so that any slight vibration of the eardrum will be transmitted faithfully through the bones to the liquid on the opposite side of the oval window leading to the cochlear canal in the inner ear.

By surgically exposing the middle ear of an anesthetized cat, Crowe was able to vary experimentally the tension of this muscle by attaching small weights to its tendon. By varying the size of these weights and noting the effect upon the transmission of various tones he was able to determine the relation of the function of this important muscle to the acuity of hearing.

The results of this experiment are as important in a positive way as were the negative results found in relation to the eardrum. When relatively large weights were attached, it was found that the transmission of low-frequency sounds was markedly impaired, whereas the transmission of high-frequency sounds was not affected. Thus, in one case, a given weight resulted in all tones below 1,000 vibrations per second being inaudible, whereas tones above 4,000 vibrations per second were entirely unaffected.

In order to analyze the influence of the reverse situation, the tendon of the tensor tympani muscle was

severed entirely, thus releasing all tension upon the bones of the middle ear. In this case it was found that the audibility of high frequencies was reduced or destroyed, although the transmission of low-frequency sounds was unaffected.

The tremendous significance of this discovery is at once evident when we remember that the common difficulty in hearing defects of old age is that of an impairment in the hearing of high tones. It would appear, then, that loss of tonus on part of the tensor tympani muscle is a prime cause of hearing defects as related to old age.

A third discovery growing out of this research also relates to conditions that improve sound transmission. Leading to the inner ear are two membrane-covered openings—one, the oval window, is occupied by the stirrup, or last of the three little bones of the middle ear; the other, the round window, closes the other end of the cochlear tube. The function of the round window has remained more or less of a mystery to date, although it has been suspected that its function was that of equalizing pressure in the cochlear canal.

Continuing the use of the Wever and Bray technique, Dr. Crowe investigated the effect of bringing pressure upon the outside of the round window by means of inserting small cotton plugs. This procedure uniformly resulted in a marked inprovement in the transmission of voice and of all tones within the speech range. This improvement is probably permanent, since trials up to 45 minutes showed no loss in the effect, and the improvement is attained irrespective of pathological

conditions. The application of appropriate amounts of pressure resulted in an average improvement of 10 decibels in all tones used. An improvement of 10 decibels means in speech an improvement of approximately 30 per cent in ordinary word hearing. As a result of this outstanding piece of work Dr. Crowe has:

1. Disproved a persistent and popular notion as to one common cause of deafness.

2. Discovered a true cause in an unsuspected direction.

3. Discovered in still another direction a partial cure for deafness, not only as related to age but also as related to many other causes.

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Chapter 14

SENSATION AND PSYCHOPHYSICS

Sense of Vision

THE accessory apparatus of the eye, like that of the ear, is very complex. Since rays of light normally travel in a straight line, the eye must be capable of movement so that it can be directed toward any visual stimulus. This is accomplished by means of three pairs of muscles, the internal and external rectus, which move the eye from side to side, the superior and inferior rectus, which move the eye upward and downward, and the oblique muscles, which cooperate with the others to produce diagonal movements. The mechanism for directing the functions of these muscles is interesting. The point of highest vision in the retina is the part called the "fovea," which lies directly back of the lens. A basic reflex movement provides that the eye will always adjust itself so that the point of highest stimulation will fall upon the fovea. This reflex adjustment is one of the early types of coordination to develop in the infant. Lateral movements appear first followed later by the ability to move the eye upward and downward. The whole reflex mechanism is usually established by the end of three months. A knowledge of this and other simple facts of the psychology of the eye gives a basis for answering certain practical questions,

such as those relating to illumination. For instance, in our study-room lamps, we have the principle that the light source should never be within the field of vision. If it is so placed, it constitutes a source of distraction because the reflex movement tends to move the eye from the working space to fixate on the point of greatest brightness, which will be the light bulb. The light must, therefore, be so arranged that it is hidden either by having it above and back of the worker or by having the globe completely enclosed by an opaque shade. The other application of the same principle is that the immediate working space should be the point of highest illumination in a workroom. This means that the general room illumination should be reasonably adequate and that a fairly small desk lamp can be used to help in close visual work.

The essential structures of the eye itself may be mentioned briefly. The frontal transparent covering is called the "cornea." When slight irregularities are present in this covering, the rays of light passing through it are distorted, giving rise to the visual defect called "astigmatism." The iris, which controls the size of the pupillary opening and hence the amount of light admitted, is itself made up of two muscles. One of these is a radial muscle, which contracts to increase the size of the pupil when illumination is low. The other muscle is a circular muscle, which contracts to reduce the size of the pupil when illumination is high. The characteristic colors of eyes are related to pigmentation of the iris. When one muscle layer is pigmented, we have the blue-eyed type. When both are pigmented, we have

the brown-eyed type. Other eye colors result from intermediate or combinations of pigmentation. The rare condition of pink-eyedness results when pigmentation is lacking.

A common form of visual fatigue with accompanying headaches results from doing close work such as reading under conditions in which the brightness of the light changes constantly. If one-half of the page is in a shadow, for instance, the iris will expand and contract with the reading of each line. The avoidance of such conditions is one of the strongest arguments for uniform lighting.

The lens of the eye is also regulated by a muscle group. In its normal position, it focuses correctly all objects over 50 feet distant. For nearer objects the lens must be thickened so as to cause the light rays to converge more sharply to a clear focus on the retina at the back of the eyeball.

In primitive life the eyes were used almost entirely for distance vision. This meant that the muscles controlling the lens could be relaxed most of the time. Civilized life, on the other hand, has brought with it an enormous increase in the amount of close visual work that the eyes are required to do. Not only reading but most domestic and factory duties require that the lens be adjusted to close vision. This means constant effort on the part of the lens muscles. Since it is not practical to compensate for this by glasses, it is well for persons to form the habit of resting their eyes occasionally by turning from the material being read or from the other work and fixating their eyes on a distant object for a

few minutes. This permits the muscles controlling the lens to relax. Eyes in which the lens fails to focus clearly without excessive and continuous effort of the muscles of the lens are said to be nearsighted if the focus is too short and farsighted if it is too long. These conditions, together with astigmatisms, are the ones most commonly treated by means of glasses. The retina contains the sense organs proper of vision. These are the rods and cones. The rods are thought to be the more primitive structures and are sensitive only to colorless or gray light. The cones, which are probably evolutionary modifications of the rods, are sensitive only to colors and to grays of high intensity. The neurons leading from the rods and cones form the large optic nerve which leads to the brain. The point at which the optic nerve leaves the retina is called the "blind spot." Vision is very poor at this point. The blind spot lies to one side of the fovea which is the center of the visual field and the point of keenest vision.

Plotting the Blind Spot. Close the left eye and look steadily at the circle below with the right eye. Now move the book slowly away from you until at about 1 foot from your face the cross will disappear. At this point the image of the cross is falling on the blind spot.

Now fixate the circle with the right eye in such a way that the cross is invisible. Move your pencil tip in the direction of the cross until the tip is invisible.

At the point where it disappears make a dot. Now continue moving the pencil out and then up and down making dots each time as the tip reappears. When a number of points have been made connect them with lines thus providing a rough outline of the shape of the blind spot.

Visual Sensations. Visual sensations fall into two large divisions: sensations of gray and sensations of colors. What is ordinarily termed "white light" can be shown to be merely gray of high intensity. Further, by means of the spectroscope or by mixing the four primary colors on the color mixer, it can be shown that gray is characteristically produced by a blend of all different light waves. Gray is thus analogous to noise in the field of auditory sensations. Sensations of color, likewise, are comparable to tones since each color is the result of a given wave length.

There are three attributes of color as there are of tones.

1. Hue is related to wave length and results in the color qualities called red, green, blue, etc.

2. Brightness is related to wave amplitude or intensity of the color stimulus.

3. Saturation or purity is related to the extent to which gray is mixed with the basic colors being considered. A saturated color is one in which there is no admixture of gray.

The interrelationships of the factors of color vision may be shown in a variety of ways. The color circle (Fig. 40) arranges the colors in order of their wave length. The red waves are the longest and the blue

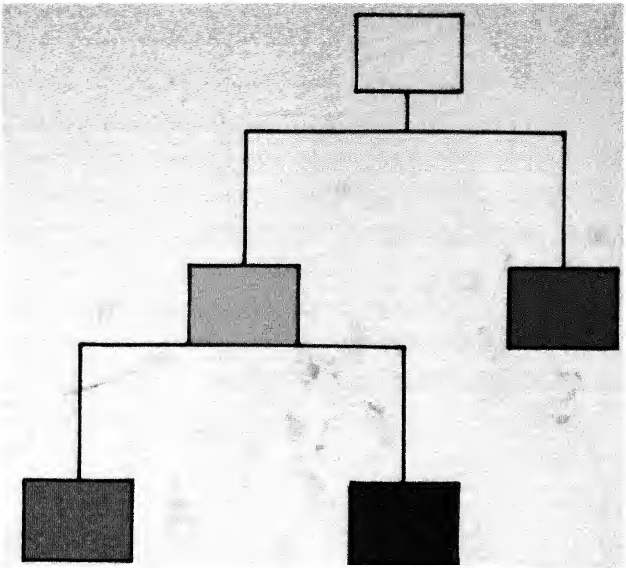


FIG. 39.—*Diagram of Ladd-Franklin color theory.*

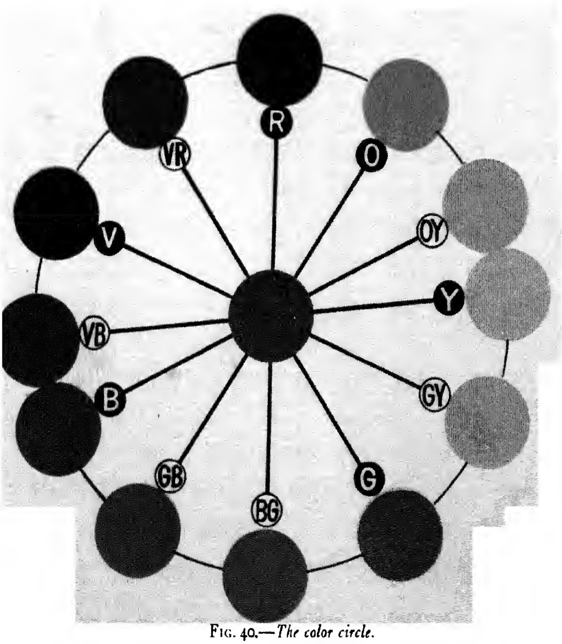


FIG. 40.—*The color circle.*

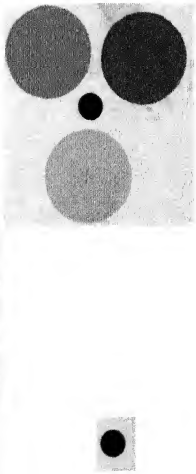
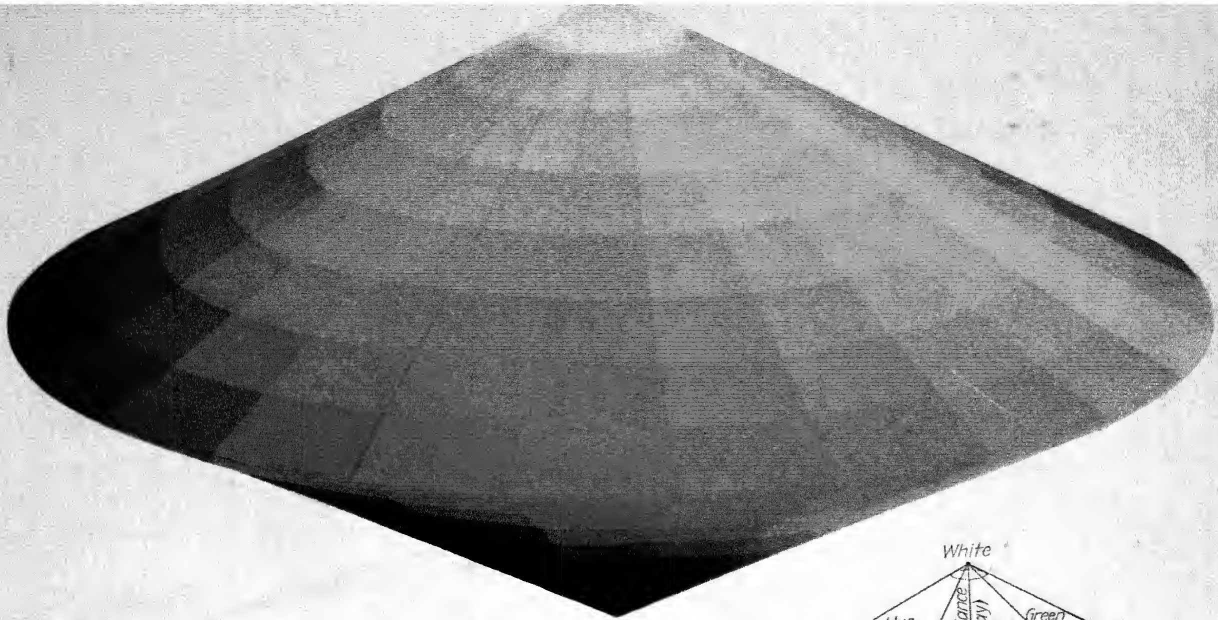


FIG. 41.—*Negative afterimages.* Stare for about 15 seconds at the central black dot so as to include all three colors in the field of vision. Then look at the black dot below. After a few seconds, an afterimage will appear on the blank paper; the red will appear as blue-green, the blue as orange, and the yellow as purple-blue.



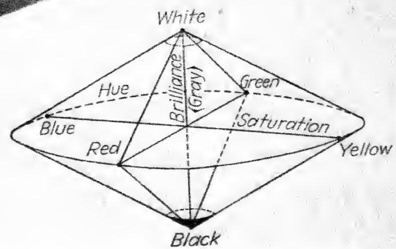


FIG. 42.—*The color solid. (Reproduced by permission from More Business, copyright, 1937, by the American Photo-Engravers Association.)*

the shortest. The colors are also arranged so that complementary colors lie opposite each other.

Exercise: Gaze fixedly for several seconds at a bit of brightly colored paper. Then look away at a gray surface. A color that is the complement of the colored paper will be seen. The true complement of any given color can be experienced in this way.

The laws of color mixing portray other interesting facts about the operation of the retina. These laws can be best understood by reference to the color circle.

1. The mixture of complementary colors produces gray.

2. The mixture of noncomplementary colors produces an intermediate color.

3. The mixture of two pairs of colors, each of which produces gray, will produce gray.

The color pyramid is an artificial construction designed to show the relations between all the variables that enter into vision. Figure 42 shows the construction of this figure and the relationships it portrays.

Visual Acuity. The simplest devices for measuring the adequacy of vision are the test type and the astigmatic charts. By means of these simple devices it is possible to discover the presence of any marked visual defect. The exact measurement and treatment of such defects should, of course, be placed in the hands of a reliable oculist.

Perimetry. The rods and cones are not spread uniformly over the retina. The study of these visual zones is called "perimetry." From such study we know that the outer portions of the retina contain only rods and

so give only gray sensations. Next most widely dispersed are the cones giving sensations of blue and yellow. Finally in a comparatively small area around the fovea, we also find cones giving sensations of red and green. These facts are interesting in themselves and are important as related to a basic theory of color vision.

Color blindness results from a partial or total deficiency in the cones. Color blindness is an inherited deficiency, being sex linked in that it is transmitted by the female and appears in about 4 per cent of the normal male population and in less than 1 per cent of women. Though an interesting phenomenon it is less important in a practical way than might be imagined. This may be realized when we recall that in the cinema we are actually living in a colorless world and yet we experience no inconveniences or incongruities. There is a tendency to view color blindness as a severe handicap, possibly because of the connotation of the word "blindness." As a matter of fact, with the exception of certain highly specialized vocations, such as railroad engineering and various forms of art work, color blindness constitutes practically no handicap. The writer once tested a young lady who had achieved some local distinction as a painter with more or less "modern" ideas. The artistic composition of her paintings was conceded to be quite excellent, but her persistence in painting red grass, yellow skies, and green barns showed much originality to say the least. As may be guessed, the trouble was that the girl was color blind. In a similar way the writer has for some time tested

students in geology classes for color blindness, since it was discovered that certain students whose general scholarship was excellent were failing in geology because they were color blind and so could not detect shadings of color upon which the classification of minerals depended. Aside from the hardships wrought in special cases such as these, color blindness usually involves almost no handicap. This is emphasized by the fact that many color-blind persons live for years before they even discover that they are color blind. An interesting illustration of the fact that color blindness may even be an asset is found in the fact that color-blind aviation observers are said to be in demand because their color blindness enables them to see through many of the forms of camouflage that are put up over antiaircraft and other military objectives and would hide them from persons with normal vision.[1]

Interest in color blindness arose in the latter part of the last century as a result of a train wreck caused by a color-blind engineer's running through a red signal. As a result of this experience Holmgren devised a test for color blindness based on the subject's ability to sort out variously colored skeins of yarn. Since Holmgren's, many other tests have been devised. Among the most accurate and easily administered is that by the Japanese physician Ishihara. This test consists of a series of colored plates from which numbers are to be read. Color-blind persons see different numbers from those seen by persons with normal vision.

[1] *Scientific American Magazine*, February, 1941, p. 103.

Ladd-Franklin Theory of Color Vision. From the several theories offered to explain the facts of color vision, the so-called evolutionary theory of Dr. Christine Ladd-Franklin will be selected for study. This theory states that primitive vision included only response to gray. Gradually some of the rods became specialized as cones and responded to yellow and blue wave lengths. Finally certain of the yellow-sensitive cones became modified to respond to red and green (Fig. 39). In this way we have arrived at the four psychological primary colors as we know them. The Ladd-Franklin theory explains three interesting facts about color vision.

1. Red-green color blindness is far more common than complete color blindness. This is explained by the fact that, if the deficiency results from an hereditary throwback, the most recent acquisition would naturally be those most frequently affected.

2. Color zones of the retina. The smaller area of sensitivity to red and green is also explainable in terms of the more recent acquisition of these receptors.

3. In color mixing it has been noted that, whereas yellow and blue mix to give gray, ordinary red and green do not. Instead they produce a faint yellow, so a little blue must be added to get gray. If red and green derived from yellow as yellow and blue did from gray these relations would be expected.

Interoceptive Sensations

Interoceptors are sensory nerve endings on the walls of the hollow organs of the body. Important among

these are the stomach, intestines, and other portions of the alimentary canal, veins, arteries, and various hollow organs such as the bladder. These little known types of sensory structures play a central role in at least two basic psychological processes. The processes are feelings and emotions and motivation.

Relation to Feeling. Feelings and emotions result from the complex patterns of internal changes related to the operation of the sympathetic system and of the glands. These changes, such as blood-pressure changes and changes of the digestive tract's function, are reported by interoceptive sense organs.

Relation to Motivation. Attention has also been called to the role of internal changes as the point of origin of urges through tissue needs. Hunger, thirst, and sex urges have been shown to be among the important sources of all human motivation. Among the earliest forms of social training received by the child and pet animal alike is that relating to the control of basic urges connected with the excretory systems. Thus human motivation and many problems of social regulation center around internal changes reported by the interoceptors.

Proprioceptive Sensations

There are two classes of proprioceptors. They are (1) kinesthetic sensations, arising from the muscles, tendons, and joints, and (2) the sense organs of equilibrium in the inner ear.

Kinesthetic Sensations. An interesting example of operation of the kinesthetic sensation is that of the

knee jerk. It has been shown that this reflex results from the stretching of the muscle to which the patellar tendon is attached rather than directly from the blow on the tendon itself. Sherrington has estimated that such myotatic or stretch reflexes can be aroused by a muscular stretch of only 1/30 inch. Similar sensations set up in other muscles as a result of their movement make possible nearly all our finely coordinated muscular action. Maintenance of balance is also dependent in large part on these same muscular sensations. The operation of similar free nerve endings in tendons and joints account for our sensations of movement in these structures.

Semicircular Canals and Vestibular Mechanisms. These structures in the inner ear cooperate with kinesthetic sensations and with other sense organs such as the eye and ear in maintaining the equilibrium of the body. Movements of the head set up movements of the endolymph which fills these structures. This in turn affects the hair cells lying in the ampula of the canals and the macula of the vestibules. The sensory impulses set up in these hair cells provide the basis for the so-called "sense of equilibrium."

The importance of these senses for vocations such as aviation is obvious. The familiar test based on spinning a subject around on a stool and then asking him to point at an object measures the effectiveness with which the semicircular canals are functioning.

Pain Sensations

Pain receptors are found in all parts of the body. Their function is that of reporting intense or violent

changes. Thus we find that almost any sensory stimulus may arouse pain responses if it be sufficiently intense. We have already seen that extremes of temperature arouse pain sensations that quite change the nature of the total response. Similarly very intense sounds or bright lights or strong pressures may arouse pain. Pain receptors are also found within the body. Muscular aches and pains, rheumatism, and bruised tendons or bones are examples of this type of pain function.

Characteristics of Pain Responses. Pain responses show little or no adaptation. Contrast in this connection the continuance of a toothache with that of an unpleasant odor. Reaction-time studies have shown that the reaction time to pain stimuli is one of the slowest responses. Erlanger has shown that this is because of a high threshold and also because of a slow conduction rate in the sensory neurons of pain. He was also able to measure the diameters of various sensory nerve axons and to show that a high threshold of irritation and slow conduction rate are related to small diameters of the axons and vice versa.

The biological significance of this condition is apparently that of protecting the organism against a constant bombardment of pain and, in the case of nonadaptiveness, to continue to warn the organism so long as truly destructive conditions are at work.

Weber's Law

The J.N.D. The German scientist, Weber, inaugurated a series of important studies on the relation between changes of intensity in stimuli and in the

sensations resulting from them. Weber approached the problem by determining the amount of increases in given stimuli that were required in order to produce a "just noticeable difference" (J.N.D.) in the sensation.

If a blindfolded subject were lifting a 1-pound weight, it is clear that he would immediately be aware of the addition of a second pound to the weight. If he were lifting a 40-pound weight, however, it is clear that he might not notice the addition of the same 1 pound. Weber, who worked largely with weights, found that to produce a J.N.D. any weight would have to be increased (or decreased) by an amount equal to 1/30 of its own weight. In other senses the size of the fraction varies, but Weber was able to state his law for every sense field as follows: *In order to produce a J.N.D. in sensation, a stimulus must be increased by a constant fraction of itself.*

Weber's law enables us to undersand many interesting phenomena in everyday life. It explains, for instance, why the stars are not visible in the daytime. The light of the stars constitutes less than the necessary fractional part of the sun's intensity. The moon, under favorable conditions, seems to have just about the necessary fractional part of the sun's intensity. When these conditions exist, the moon is "just noticeable" in daylight. To take an extreme example in another direction, we know that the ticking of a clock is easily audible in the quiet of night but that the same sound is quite unobservable during the greater noise of the day.

Psychological Uses of Weber's Law

The decibel is a unit used originally by telephone engineers in measuring sound intensities. Actually, a

decibel is approximately one J.N.D. in loudness above a given point. Decibel meters are being used currently in measuring intensity of the applause to numbers offered on "amateur hours" on the radio. Industrial psychologists use similar decibel meters in measuring the noise of street traffic in connection with the study of the effects of noise upon the efficiency of office and other workers.

Measurement of Special Aptitudes. In later sections we shall give detailed consideration to measuring devices for determining special aptitudes. Many of these tests are based on the principle of Weber's law. In passing we may notice the Seashore tests for musical talent. In these tests the object is to determine the smallest increase in pitch, intensity, consonance, etc., which will produce a J.N.D. in the subject. In the Meier-Seashore art test the ability to observe slight differences in the quality of paintings is measured. Sensitivity to changes of these kinds varies greatly with individuals and opens up the way for selecting persons especially well endowed in a given direction.

Rating scales for evaluating quality of work are among the most practical applications of Weber's Law. Samples of penmanship may be easily graded by means of handwriting scales. In such scales each sample of handwriting has been agreed upon by a committee of experts as being just noticeably superior to the preceding. The scale thus represents steps of excellence, each one better by one J.N.D. than the other. In use, the sample to be graded needs only to be moved along the scale until the step it most resembles is reached. In Civil Service and other vocational selection work, scales of

this sort can be devised for rating many kinds of work. Figure 43 shows the use of rating scales in judging the quality of handwriting and in judging the quality

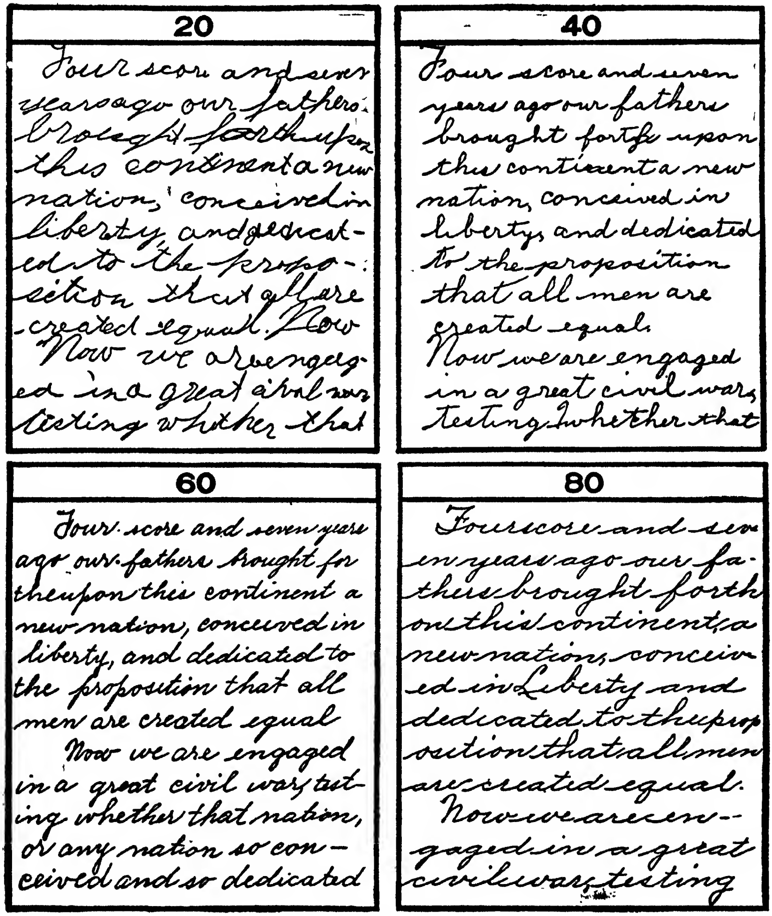


FIG. 43.—The Ayres handwriting scale. (*By permission of the Russell Sage Foundation.*)

of work in splicing telephone lines. These devices do very much to enable us to avoid the subjective judgments which we have already seen to be so inaccurate.

Rating scales are also extensively used in personnel work. We have already seen in our studies of personality how very difficult it is to obtain an objective evaluation of another person. At the same time, supervisors, employers, teachers, and many others constantly find themselves under the necessity of making just such judgments as to the quality of work turned out by persons under their direction. Rating scales for personality traits help to set up in the mind of the rater certain more or less objective standards of comparison. Descriptive phrases set along a line following each trait to be rated should be thought of as roughly comparable to the handwriting samples pictured in Fig. 43. Personnel managers find that rating scales are valuable not only in the better judgments of their supervisors but also in "getting a line" on the supervisors or other raters themselves. When one has in hand 15 or 20 ratings by a given supervisor, it is not difficult to see whether the supervisor has a tendency to underrate or, on the other hand, to be overcritical. An analysis of his ratings will also frequently reveal certain points that tend to predominate in his ratings. Rating scales in the field of personnel work do not, then, provide completely objective methods of evaluation. Nevertheless, by means of a careful interpretation of them, it is possible to improve greatly the accuracy of work in this field.

SUGGESTED READINGS

CRAFTS *et al.*: *Recent Experiments in Psychology*, Chap. 9.
CRANE, G. W.: *Psychology Applied*, Chaps. 8, 12.

GARRETT, H. E.: *Great Experiments in Psychology*, Chaps. 12, 15.

KELLER, HELEN: *The World I Live in.*

VALENTINE, W. L.: *Experimental Foundations of General Psychology*, Chap. 15.

WARREN and CARMICHAEL: *Elements of Human Psychology*, Chap. 5.

WOODWORTH, R. S.: *Experimental Psychology*, Chap. 22.

Chapters on Sensation in any standard psychology textbook.

Chapter 15

ATTENTION AND ATTITUDES

One of the first things that we heard when we started school was our teacher urging us to "pay attention." To most of us it was never made clear just exactly what we were expected to do in order to pay attention. What is attention? Like most topics dealt with in psychology, we are inclined to view it as a general mental state or condition of the mind. Such vague terminology cannot satisfy the needs of the psychologist. Here, as elsewhere, he has found that by pushing the investigation back to the starting point of biological utility, he has been able to arrive at a functional and more useful understanding of the topic.

Paying attention is not something that happens to the mind. Indeed its most obvious characteristics are related instead to the gross structures of the body. When a horse pays attention it lifts its head high, focuses its eyes upon the object, and "pricks up its ears." This last movement, involving a definite adjustment of the external ear, typifies attention. The whole posture taken by the animal indicates a readiness to receive stimuli. When the runner is on the mark, he is all attention, he is listening intently for the sound of the gun,. his eyes are fixed on the track he is to traverse, and every muscle is active and ready to begin movement.

Our definition of attention grows out of these twin processes of sensory and muscular set. *Attention is a complex adjustment of the organism preparatory to receiving and to reacting to stimuli of a certain class.* Paying attention, in other words, is not merely getting ready to hear, see, smell, or feel something; it also involves the getting ready to react to these stimuli as rapidly and as efficiently as possible.

Everyday life is full of illustrations of the advantage that "getting set" gives to one. The great advantage of using a pointer in bird hunting is that the pointer indicates the approximate location of the bird so that the hunter can assume the necessary postural set. The writer has noted that even in hunting without a dog he will be far more likely to make a clean hit if in hunting quail he has seen the bird run into cover so that he knows approximately the place from which it will fly. Such shots will frequently be successful where one will miss a shot that is essentially much easier when the bird appears unexpectedly.

Our understanding of the nature of attention as a complex biological process of this sort has grown out of a number of interesting experiments.

Postural Set in Reaction Time. One of the earliest observations growing out of the work on reaction time was the discovery that reaction time varies according to whether the subject takes what is called a sensory or a motor set. It was learned that most inexperienced subjects assumed what was called "sensory set." This meant that their attention was centered upon the stimulus that was to come. As a result, the reacting

mechanisms were not entirely ready to act. As a consequence of this, the reaction time was found to be longer than that of subjects who had learned to assume what is called the "muscular set." In the muscular set attention is focused on the movements that are going to be required to lift the finger from a telegraph key. Studies have shown that muscular reaction time will be shorter by some $^{25}/_{1000}$ to $^{50}/_{1000}$ second than sensory reaction time. The author[1] has shown that, even in the case of very simple reflex movements such as the knee jerk, reaction time will be changed by changes in muscular set. In a study of the reaction time of the knee jerk it was found that when the subject was tensed the reaction time dropped from an average of $^{63}/_{1000}$ second to $^{58}/_{1000}$ second. In this case the change in muscle tonus of the leg came about involuntarily as a result of a change in general muscle tonus, but the effect was the same as in the case of the muscular set in simple reaction time work.

A second bit of light has been thrown upon the nature of attention in connection with the study of reaction time. This study had to do with the effect on reaction time of varying the preparatory interval. In reaction-time experiments it is customary to give the preliminary or ready signal before the actual stimulus occurs. The object is to give the subject an opportunity to pay attention, *i.e.*, to make the needed motor adjustments. Woodrow[2] performed an experiment to determine the ideal preparatory interval. He allowed intervals

[1] VARNUM, W. C., "Factors Influencing the Latent Time of the Patellar Reflex," *Journal of Experimental Psychology*, Vol. xvii, No. 4, August, 1934.

[2] Reported in W. L. Valentine, *Readings in Experimental Psychology*, p. 183.

of from 1 to 35 seconds to elapse between giving the warning signal and presenting the stimulus. The 2-second interval gave the shortest reaction time. With an interval of only 1 second the subject did not have time to complete the postural adjustments, with the result that this average reaction time was $\frac{145}{1000}$ second. With a 4-second interval the subject has reached maximum adjustment and has been unable to maintain it, with the result that this reaction time is slowed down to $\frac{150}{1000}$ second. At 2-second intervals, the organism had apparently reached its maximum adjustment and was ready for the response. The result is that the average reaction time was only $\frac{136}{1000}$ second. Longer preparatory intervals up to 32 seconds brought progressively increased reaction times. The results of this experiment are of importance in such practical applications as athletics and other contests, and in such conditions as automobile driving.

A variation of this experiment which illustrates the value of having a preparatory period in which adjustments can be made is shown in the second part of the experiment by Woodrow, where the preparatory intervals varied from 4 to 20 seconds but with the intervals scrambled so that the subject never knew for a given experiment just how long a preparatory interval he was to have. Three results were observed. The first was that all reaction times were strikingly lengthened. Thus, whereas it took only $\frac{150}{1000}$ second to respond when the preparatory interval was known to be 4 seconds, it took $\frac{210}{1000}$ second to respond with a 4-second interval when it was not known exactly what

the interval was to be. For the 12-second interval, the time was increased from $^{181}/_{1000}$ second to $^{199}/_{1000}$ second. The second important result is that under the second condition the advantage obtained by the preparatory interval is largely lost. Thus the reaction time for the 4-second interval is actually longer than the average time for the 20-second interval. This experiment shows that, in order to adjust properly or to pay attention to a given stimulus, a knowledge of how long the preparatory interval will be is required. Furthermore, it is probable that the more complicated the adjustment process the longer the preparatory interval will need to be.

Another experiment illustrating the importance of postural response is found in the complication clock experiment. This clock is a mechanism so arranged that a bell can be sounded when the clock hand is at any predetermined point on the dial. The subject is asked to note the position of the hand at the time the bell rings. It has been shown that if the subject has been instructed to pay attention to the clock hand and to let the sound of the bell take care of itself, he will report the hand of the clock as being farther along than it actually was at the time the bell was struck. If, on the other hand, he is told to listen particularly to the bell, it will be found that he will state the position of the hand to be an average of as much as 8 or 10 degrees behind its true position when the bell sounded. In other words, the subject is best able to report that type of stimulation for which he has made a particular adjustment.

Delayed Reaction in Dogs and Rats

Hunter has carried out an interesting experiment upon dogs and rats which illustrates the importance of bodily positions for successful reactions among animals. The animals are placed in a glass-fronted compartment, through which they can see three doorways. Each of these doors may be independently illuminated by means of a small electric light. Now, it is not difficult to train an animal to select a lighted door in trying to find his way to food. In the present experiment, however, the animal is retained in the starting box while the light over the correct doorway is allowed to burn for a few moments. Then the light is extinguished but the animal is still held in the box for a period of from 1 to 10 seconds before being released. The question now is can the animal retain or remember the correct response to a stimulus not now present? The answer is that, if the animal turns toward the lighted box and then remains in that position without moving from the time the light goes out until the cage is opened, he will immediately and without error go to the correct passageway; but, if the animal moves or changes his posture during this interval, he will be incapable of selecting the right passage. This experiment further illustrates what we mean when we say that attention is a form of postural response. It also gives us a valuable hint as to the nature of the process that takes place in the human in what we call memory or remembering. Without going into a discussion of this difficult problem, it may be suggested that remembering is the main-

tenance of such bodily postures in the form of symbolic cues.

Postural Response in Human Beings

The importance of postural responses in human beings has been shown by a variety of interesting experiments. One is called the "weight illusion" experiment. The subject is presented with two weights of equal size but of markedly different weight. One may weigh 500, the other as much as 2,000 or 25,000 grams. If these two weights are lifted alternately each with one hand, *i.e.*, the light weight with the left hand and the heavy weight with the right hand, it will be found that, when the hand that has been lifting the light weight attempts to lift a third weight, the new weight will seem heavier and will be lifted more slowly and to a lesser height than when it is lifted by the hand that has been lifting the heavy weight. In other words, the hand that has been lifting the heavy weight has made a general or a postural adjustment for a strong effort. This posture is transferred to the new weight so that it is lifted much more rapidly and much higher by this hand.

Attention and Concentration

To the psychologist, then, "attention" refers to a process of getting ready to carry out a given line of action. The sprinter at the starting line provides a perfect picture of attention. He is not yet in motion, yet every muscle that is to be involved in running has been raised to a high level of tonus. Tonus, we may

remember, occurs when the muscle is in a state of partial contraction. When tonus is high, a larger proportion of the muscle fibers is active. In attention, the muscles that are to be involved in the forthcoming action are in a high state of tonus. Paying attention to something is then an active process. In paying attention we are already doing the thing, but we are doing it at the implicit level. The importance of attention lies in the fact that this implicit doing of something helps greatly in getting started and in carrying out the actual process. When we pay close attention to our studies, it means that all the bodily processes important for that study are held in readiness to act. The muscles are not permitted to act with regard to any outside or unrelated stimuli. Attention is important, therefore, not only because it helps us to do the things we are going to do more efficiently, but because it helps us to avoid the doing of many non-essential things.

Concentration as the Habit of Attention. Concentrating on a subject is exactly the same thing as paying attention to it. There is no such thing as the "power" of concentration. The ability to concentrate results from a process of habit formation. We can learn to concentrate by forming habits of holding our muscles strictly to a given line of work. The muscles involved are, of course, chiefly the muscles of the eye, the muscles involved in writing, and, sometimes, the muscles used in speaking. As we have said, the elimination of contraction in unrelated muscle groups is just as important a part of paying attention as is the contraction of the related

ones. The picture of the beginning typist offers an instructive illustration. The muscles of the fingers are those chiefly concerned in typing; yet the beginning student will be seen to be biting his tongue, twisting his feet around the legs of his chair, and otherwise exhibiting unnecessary muscle tensions. This results in not only a loss of energy but in a distraction in what he is doing. The skilled typist or the athlete performs difficult feats with apparent ease. The smoothness and simplicity with which they act result from the fact that only those muscles needed are active, but they are active to a maximum degree. The best way of doing a thing is always the easiest.

Three Stages of Attention. Attention normally passes through three stages. In the first stage, attention is held by curiosity. The subject is new, and there are many angles of it that can be easily contacted. In beginning a new course, there is always the interest in glancing through the new textbook and in becoming acquainted with the new instructor. In the second stage, attention must be forced. The spontaneous interest related to curiosity has begun to lag, and yet the student has not developed sufficient background to provide a purely basic interest in the subject. It is in passing through this stage of attention that the student needs to "gird up his loins" and drive himself through to reach the third stage. The third and final stage of attention is that growing out of an intrinsic interest in the subject. At this stage the student is beginning really to understand the problems and possible solutions of his subject matter. He has begun to feel the possi-

bilities of mastery. These things provide a basis for permanent attention value in any subject. Once the student reaches this stage, he usually will experience no further difficulty from this phase of his study technique.

Absentmindedness. Most people think of absentmindedness as representing a defect in the ability of the absentminded person to pay attention and to concentrate. At the same time, we all think of absentmindedness in terms of the classic picture of the absentminded professor. Does this mean that all professors are suffering from poor habits of attention? If we analyze the situation for a moment it will become obvious that absentmindedness is related to a very high degree of attention. The absentminded professor is actually paying very close attention to problems about which he is thinking. His concentration is so great, as a matter of fact, that he fails to note or pay attention to other minor questions relating to the mechanical routine of life. Thus, he may forget his hat or climb into the wrong automobile because he is engrossed at the moment in the consideration of some important philosophical question.

Attention in Advertising

The expressions "fix your attention" and "holding the attention" have become so widely used that most of us believe attention to be stationary and inactive. Nothing could be further from the truth. Attention is always mobile. It is true that the range of activity in attention is narrowed, but, within its own field, activity is more intense than it is in cases of nonattention. The

explanation of this lies in the fact that attention involves a readiness to respond. As has been explained in an earlier section, getting ready to respond actually means responding at an implicit level. When you pay attention to a given stimulus, you are already beginning to respond to it. The success with which we meet the situations in our complex lives depends to a great extent upon the completeness with which these attention processes are carried out.

Factors of Advantage in Attention. We may consider six factors that result in attention value:

1. Intensity: The more intense a stimulus the more likely it is to attract our attention. This accounts for the use of brightly illuminated signs and the effort to devise billboards in such a way that visual contrasts will give the effect of intensity. The use of large, unfilled space with the advertising message in a strongly contrasting color provides a practical example of this.

2. Size: The larger the advertisement the more it is likely to enjoy our attention. There are two reasons for this. In the first place, size provides a greater total mass of stimulation; secondly, if the advertisement is large, it occupies an increased proportion of the visual field and hence eliminates just that much in the way of possible conflicting stimuli. It is for this reason, in part, that magazine advertisers sometimes take a double page. In this way they can be sure that while looking at the particular section of the magazine there will be no competitors for the attention of the reader.

3. Repetition: The principle of repetition is one of the most effective of our six factors of advantage.

Repetition also has a twofold function. First, the repetition of the impulse provides the equivalent of greater intensity. This takes the form of what psychologists call a summation effect. In the second place, repetition provides a hint of animation or at least of movement, which in any form is always important as a device for getting attention. This is because we have learned through experience that moving or changing objects in our environment are more likely to be significant to us than are static ones.

4. Novelty: Novelty in the form of unusual color combinations, unfamiliar types of print, striking pictures, and the like attracts attention. Again, in terms of our past attention habits, novel things in our environment command our attention. This is because they may or may not be significant to us. We give our attention to the object at least long enough to find out whether or not it demands definite response on our part. In advertising this momentary fixing of attention through novelty is the very thing sought for.

5. Movement: Moving objects are prime attention getters. Again, the psychology of the situation lies in the fact that movement, whether in the form of the action of living things or in the movement of inanimate objects, represents situations which most frequently demand a definite adjustment by us. Particularly in billboard advertising, where the observer is moving along in some vehicle, movement is of great importance. Because the rider has trained himself to be on the lookout for moving objects on the road, he will be almost compelled by his habit patterns to give momentary

attention to any moving object. The great success of electric signs in which there is apparent movement traces back to this factor. In most of the animated signs the movement is pure illusion. The use of neon lights has made it especially easy to employ the principle of the *phi* phenomenon in getting illusions of movement. Nowadays it has become commonplace to see horses apparently running along race tracks, arrows darting back and forth, and the like. If you analyze these signs you will find that there is actually no movement whatever taking place. Rather, a series of neon tubes are illuminated in rapid succession in such a way that the eye fills in the spaces so as to give an inescapable feeling of movement. The use of motion pictures projected on large billboards represents another step in advance in the application of the principle of movement to advertising.

6. Habits or Other Organic Condition: In discussing the preceding factors of advantage in attention, we have had occasion to mention the fact that the habit patterns of the individual play a large part in determining those things to which he will give attention. In addition to these habits, we must take into consideration organic conditions in the form of urges. It is obvious that a hungry person will be more inclined to give his attention to advertisements relating to tempting foods than will one who has just dined. The smoker who has neglected to buy cigarettes will be attracted by the tobacco advertisements he encounters.

All these factors, together with their complicated interrelationships, must be taken into consideration by

the advertising man who wishes to obtain the greatest effectiveness from his advertisements. Because of the large amount of money involved in this field, it is probable that the psychology of advertising has been carried to as high a state in practical development as almost any other phase of applied psychology. In our next section, however, we shall have occasion to study various types of advertisements and to see that many errors in advertising technique are still to be found on our billboards and in our magazines.

Psychology in Advertising

Some notion of the techniques in modern advertising may be gained from a brief consideration of the psychological factors involved in two fields of advertising.

Printed Matter. Under printed matter we would include all advertising in magazines and newspapers, handbills, and direct-mail advertising. A major problem confronting the advertising man is that of determining the effectiveness of his advertisements. Aside from the field of radio, two major nonlaboratory methods of approach to this problem are open. First, effectiveness can be measured in terms of increases in sales. This would seem to be the obvious method of attack. In practice, this method confronts many difficulties. In the first place, many other factors are constantly contributing to the total sales volume, and, in the second place, any large company will have an advertising program of such great size that it will be difficult to determine the role that any one phase of it is playing. In order to avoid this difficulty, advertisers have

adopted the technique of what might be called research areas. They will select a certain city with its adjacent rural area and present to this community one specific phase of their total advertising campaign. If the same thing be done in other communities with different phases of these campaigns, it is frequently possible to get a measure of the relative importance of the different advertising activities.

The second technique for measuring advertising effectiveness is through the use of questionnaires. Questionnaires are circulated among individuals who may be expected to cooperate—oftentimes, in order to get some little reward or a chance at winning a prize. The results of such questionnaires sometimes not only indicate the effectiveness of the advertising but show whether or not the product itself is meeting the demands of the public. The General Motors Corporation, under the direction of Mr. Weaver, has recently conducted a very extensive questionnaire study of this type. As a result of this study the company effected several rather drastic changes in the body styles of their automobiles. This study is interesting from a psychological standpoint as the questionnaire used offers an excellent example of a good questionnaire make-up for market research. It is informal, brief, and has been made interesting through the use of clever pictures relating to the questions. Filling out of the questionnaire has been simplified by providing for answering the questions through checking squares. Even this process is further simplified by having the subject referred to by the various squares presented in the form of pictures.

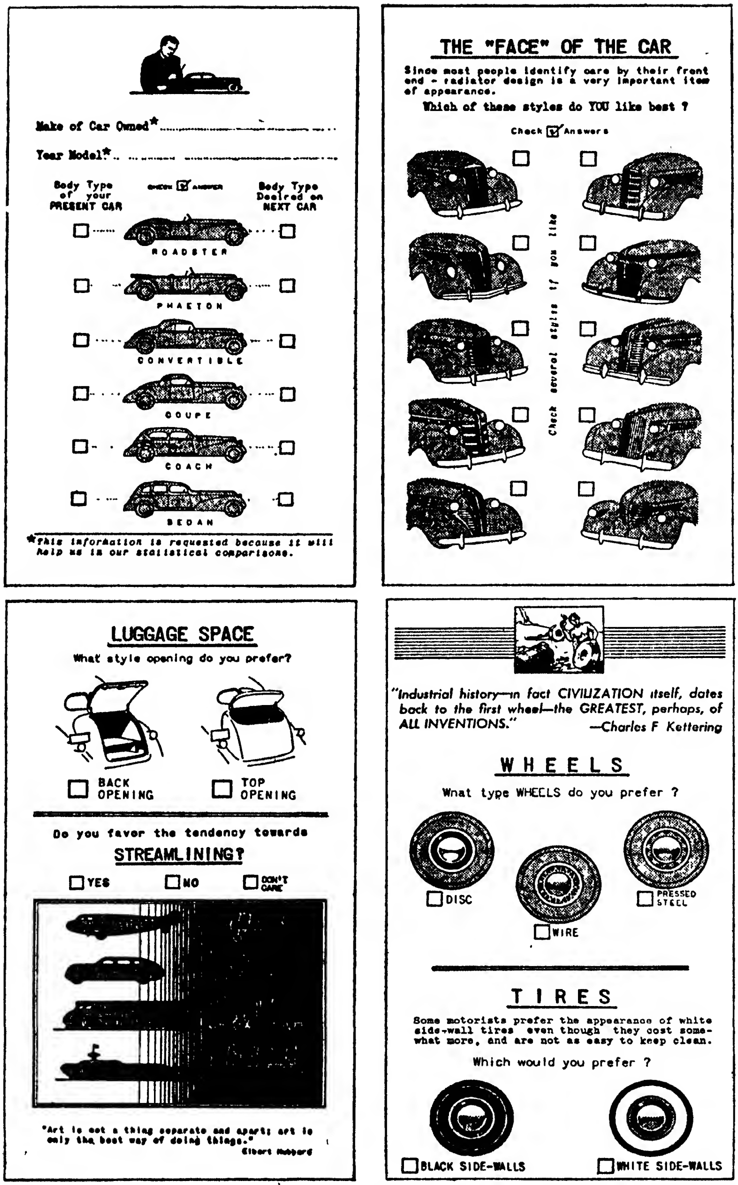


FIG. 44.—An example of a modern industrial questionnaire. (*Courtesy of Customer Research Staff, General Motors Corporation.*)

The result of an advertising survey in which the writer participated throws some interesting light on the probable effectiveness of certain common advertising techniques. Some of the questions were answered in a way that would indicate that the public is developing an increasing callousness to ordinary propaganda methods. On the other hand, in answer to the question "Do you think advertising has an educational value?" 93 per cent of the persons answering said, "Yes" with only 7 per cent giving a negative answer. Perhaps the readers meant to imply the truth that education may be good or bad, for in answer to the question "Has advertising ever led you to form a mistaken impression of a product?" 60 per cent of those answering gave an affirmative reply. The pictorial side of advertising contributes much to reader interest in newspapers, if we are to judge from the fact that 91 per cent of the readers gave an affirmative answer to the question "Are you more likely to read newspaper advertisements when they are illustrated?" Something of a jolt was handed to those firms which rely largely upon handbills as their medium of advertising. Seventy-seven per cent of the people answered "No" to the question "Do you generally read the advertising which is thrown into your yard?" The sponsors of the questionnaire had thought it likely that shoppers would express a dislike for shopping in the crowded downtown sections where traffic conditions were bad. As a matter of fact, 64 per cent of the people answered "No" to the question "Do you dislike to shop in your downtown section because of traffic conditions?" Apparently, the satis-

faction of mingling with crowds overcomes the inconvenience experienced therefrom.

Experimental Methods for Measuring Effectiveness of Advertising. In addition to the above methods, the effectiveness of advertisements can be studied experimentally in the psychology laboratory. Illustrating these methods is the technique for measuring the effective value of colors. The method of paired comparisons, which has long been used in studying this subject, can be applied equally well in measuring the effective value of advertisements in general. In the method of paired comparisons, a group of colors or advertisements is assembled. These materials are presented two at a time to a group of subjects. As each pair is presented the subjects record their preferences. Preference is recorded in terms of the pleasantness or unpleasantness aroused by the materials. This process is continued until each item in the series has been paired off with every other item. Thus, for a series of six colors it will be necessary to record the results of 15 paired comparisons. The formula for determining the number of presentations required to present each subject paired with every other subject is $\frac{n(n-1)}{2}$, where n is the number of objects in the series. Thus, where there are six colors to be studied by the method of paired comparisons the formula becomes $\frac{6(6-1)}{2}$. Solving for n, we find $n - 1$, or 5, times n, or 6, equals 30 divided by 2 equals 15, the number of paired comparisons required. One such study relating to six single colors showed that men

choose colors in the following order from greatest to least popularity: blue, red, green, violet, orange, yellow. Women showed preferences in the following order: blue, red, green, yellow, orange, violet. These results may vary, of course, from group to group. The results will also be influenced by the particular shade, intensity, and saturation values of the given colors. Since we are, for practical purposes, dealing in colors in terms of printers' inks, it frequently happens that the colors used will vary considerably. From the standpoint of pure scientific research, this, of course, is bad. On the other hand, from the standpoint of measuring actual advertising in which color is used, it is a situation that must be met, since the advertisements appearing in magazines will have to use the colors as provided by printers' inks. This brings us to the important question of measuring the effective value of specific advertisements.

In measuring the effective value of an advertisement, we are dealing with a total product. Even if we could isolate the separate factors, color make-up, subject matter, etc., we should not get a result that would be valuable from the standpoint of the advertiser. The reader responds not to these separate elements but to the total advertisement. It is a matter of common sense to measure effective value of advertising in terms of complete advertisements. Studies conducted by the writer have shown that, of six advertisements, one in black and white and the rest in color, there have been expressions of opinion averaging more than six to one in favor of a given advertisement over all its competi-

tors. In one such study classes of 40 consistently voted 25 to 30 in favor of one advertisement dealing with automobiles and gave no votes at all to a colored advertisement in the same series dealing with silverware. Now, the interesting thing is that silverware may be assumed to have but one basic appeal—the aesthetic one. Surely, an advertisement for silverware cannot be very effective if it does not arouse a pleasant feeling tone in terms of its own aesthetic make-up. When we remember that single-page ads in our large national weeklies cost between $3,000 and $6,000 for a single issue, we realize that the matter of measuring relative values is a very real business, as well as psychological, problem.

Practically everything that has been said of advertising in the form of printed matter, in general, holds true for billboards. In the case of billboards, the observer is moving past the advertising material, whereas in the case of the printed page, the reader is turning over the pages of the advertising material. Techniques for measuring the relative effectiveness of billboard advertising will follow much the same procedure as that for other printed materials. Special problems that present themselves and demand specialized research methods will be questions as to the best location for billboards, the desirability of electrical illumination with its subquestion of adding moving or animated features, and the questions of how the billboards should be lighted and how long the lights should be kept going. In the advertising survey referred to above, it was

found that in answer to the question "What soap posters have you seen recently?" there were more than twice as many votes for the brand of soap receiving first position as there were for the brand receiving second position. There were more than ten times as many votes for the brand receiving first position as there were for any soaps other than the one receiving second position. In other words, in the community covered by the survey, one single brand of soap had enjoyed a virtual monopoly so far as the success of its billboard advertising campaign was concerned. A checkup showed that this brand of soap also enjoyed a phenomenally large sale in the community. To the question "When does outdoor (poster) advertising most attract you: day or night?" Fifty-seven per cent of those answering indicated day and 43 per cent night. If this represents the typical situation, illuminated advertising is required in order to enjoy the "second" 50 per cent of billboard advertising effectiveness.

Radio Advertising. The field of radio has opened an entirely new series of problems for the advertiser. Advertisers were very slow, at first, to spend their money for something so ephemeral as the human voice sent out over the air. They argued that there was nothing permanent in the advertising and that its results could not be measured. From this early negative standpoint, advertising has now developed to the point where it is the undoubted financial backbone of the radio even though it may be the anathema of listeners in general. It is true that in radio advertising the

factors of advantage that can be used are limited. Size can be supplanted by duration, but here care must be taken that the duration does not extend beyond the patience of the listeners. Movement is, of course, impossible. Novelty is possible within certain limits, and intensity is strictly limited as to both tones of the voice and intensity of musical instruments used. The limits of auditory intensity are reached very early in radio. The quality of introducing a certain commercial program by trumpet sounds has in some cases been overdone in the sense that the trumpet blasts are disturbing and call forth a negative-feeling tone on the part of the listeners. In response to the question "Do you listen to radio advertising with interest?" 74 per cent of the people answered in the negative. Consistent with this was their reply to the question "Do you merely tolerate the advertising for the sake of entertainment?" in which 77 per cent gave an affirmative answer. To the question "Do you turn the dial to some other program (to avoid the commercial phase)?" 77 per cent again answered "Yes."

What are the relative values of different hours of the day for radio work? In answer to the question "Do you often use your radio after 10 o'clock?" 69 per cent of the people answered "No." Finally 66 per cent of the people indicated that they had marked dislike for the sound of certain voices over the radio. Each of these expressions of marked preference as to radio features raises problems that must be met by the advertisers if this field of advertising is to retain its effectiveness.

Social Attitudes

Like attention, an attitude is not a purely "mental" condition but a matter of general bodily orientation. This means that the general muscular system has undergone changes in tonus that favor the carrying out of certain lines of action. *An attitude may be defined as a persistent tendency to act in a particular way in a given situation.* A social attitude will then, of course, be seen as a tendency to act toward other people or toward the symbols of society in a particular way. Thus a person who has a race prejudice against Negroes carries with him a more or less permanent readiness to withdraw from or disagree with persons of this group. In the broadest sense social attitudes constitute the bonds that hold societies together. The term "patriotism" relates to a group of positive attitudes relating to the flag, the national anthem, the president, or other symbols of the body politic.

The study of human attitudes constitutes one of the most fundamental problems in social psychology. In addition to responses, that is to say, readinesses to respond, which are more or less involuntary, we have voluntary responses that also affect perception. Let us suppose a sprinter to be on the mark waiting for the word to go. The starter calls, "On your marks—get set—back up!" What will happen? In all probability, the sprinter will do nothing of the sort, but will dash down the path. The reason for his dashing forward instead of backward is that he has already so far begun a given

response that the stimulus is interpreted or perceived in light of his own response.

Another illustration of voluntary responses comes from a statement of the famous French philosopher, Pascal. Speaking of prayer, Pascal said that if the person finds it difficult to pray or to attend church, he should first voluntarily enter the church, then, if he still has difficulty, to voluntarily kneel before the altar, and, if he still cannot pray in sincerity, he should at least move his lips as though he were praying. The thought is clear. If one will carry out the movements related to a given type of religious or other experience, there is a greatly heightened probability that the objects or sensations which give rise to the religious experience will operate on the individual and lead him to a true religious faith.

Measuring Social Attitudes

A device for measuring social attitudes has been presented by the sociologist, Bogardus, in his concept of "social distance." To determine a person's social attitudes toward members of another race, Bogardus presents a graded series of social relationships ranging all the way from the most formal and casual social contacts to the most intimate, such as marriage or close friendship. Social distance is measured in terms of the intimacy of relationship that one person would willingly accept with regard to different groups. Probably most white persons who pride themselves on their lack of race prejudice would not, when it comes down to actual cases, be willing to marry a person of the colored race. Certainly those white people who are willing to marry

into this group can be said to be truly free of race prejudice. Less complete degrees of freedom from race prejudice are exemplified in Bogardus' test by those persons who, though unwilling to intermarry with members of the Negro, Oriental, or other groups, nevertheless accept them willingly as associates in school, clubs, or sport activities.

Unlike the Bogardus technique for measuring social distance, the Thurstone scale measures social attitudes by asking the subject to react to rather generalized propositions about the group or opinion in question. For instance, in the questionnaire relating to the attitude toward the Negro, the subject is requested to express his agreement or disagreement with matters ranging all the way from such a moderate position as "social recognition should be based on culture without regard to color" to the violent anti-Negro feeling expressed in such a statement as "the great majority of Negroes should be treated as well-trained apes." By tabulating the results of questions ranging between these two extremes it is possible to establish a scale according to which a person can see himself as more or less prejudiced against the group in question. In a similar way attitudes toward communism, the Catholic church, or birth control can be measured.

In his research Moore has found that radicals and conservatives do not differ characteristically in general intelligence, but that radicals tend to be more individualistic and are able to break their habits more easily than are conservatives. Also, radicals are about

18 per cent quicker in reaction time and are also quicker in making decisions than are the conservative persons.

Harper has devised a social study consisting of seven propositions relating mostly to religious beliefs and political and economic beliefs, centering largely around the question of socialism and internationalism together with some questions as to opinions regarding the proper conduct of education. The general tenor of the test provides an index of conservatism, radicalism, and liberalism on the part of the subjects.

By presenting this questionnaire to a large number of educators of various degrees of standing in their profession, most interesting facts were learned. It was found that the more highly educated these leaders were and the more responsible the positions held by them, the greater was their tendency toward liberalism.

Such a study is of interest as indicating the relationship that may exist between education and liberalism and also is of considerable interest as a barometer for changing public opinion.

It is clear that the course of international events may change race attitudes very rapidly. Up until the time of the Second World War, the American people had made pretty substantial progress toward overcoming race prejudice. Anti-Negro and anti-Japanese sentiments had been reduced by the process of education to a relatively low level. Meantime, psychologists and anthropologists had been busy attacking some of the underlying fallacies regarding race to the extent of showing that the concept of race itself is nothing more than a convenient abstraction. With the outbreak of

the Second World War, race prejudices, which turn out actually to be national, economic, or religious group prejudices, have unfortunately again been pushed to the fore. Nazi ideology resurrected the old "Nordic myth" in the form of a supposed distinct white race, the Aryans, who, they pretend, have qualities quite distinct from other branches of the white race and particularly, of course, from the Jews. In our own country the war situation has tended to revive many prejudices such as the anti-German and anti-Japanese together with establishing a possibly new positive race attitude, *viz.*, pro-Chinese.

A scientific approach to all this shows that for various economic or other practical reasons, one group may oppose another. This is quite different from pretending that the antagonism is justified on the grounds that the other race is inferior. One of the finest of many excellent contributions to the understanding of race and race attitudes has been the book entitled *Race* by Dr. Benedict, an outstanding anthropologist from Columbia University. In this book Benedict shows clearly the falsity of most of the assumptions made by advocates of race differences and in turn shows how these race prejudices, which cause so much havoc in our civilized world, are actually founded on economic, religious, and other similar but hidden interests.

Our concern as psychologists is primarily to show that race attitudes, when instilled through propaganda or through other educational pressure devices, operate in an unreasoning fashion but operate definitely to

change and, in many instances, to wreck the normal course of human relations.

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Chapter 16

PERCEPTION AND THE WORLD OF ILLUSION

OUR previous chapters have shown us the way in which sensations are brought into the nervous system. A sensation cannot become significant for the organism until it has resulted in action. Indeed, as we shall see, the meaning of an object is best understood in terms of the action it arouses. Early psychologists developed what was called the "context theory" of meaning, according to which the meaning of any object could be understood only in terms of the other objects with which it was associated. For instance, a horse has meaning only as it is associated with a wagon, a harness, barns, etc. The "context theory" of meaning provides a useful introduction to the explanation of meaning, which we propose to use here.

This present theory of meaning is called the "response theory" and has been roughly defined in the above sentences. Examine Fig. 45. At first sight you will probably see a staircase. It is perfectly obvious, however, that the figure is nothing more than some lines upon a white surface. A staircase is interpreted from the figure, because you know that it stands for an object, relative to which you will carry on certain activities. But notice further that if you examine this staircase

figure and imagine yourself to be walking upstairs, you will see the staircase figure as viewed from the top. Now imagine that you are standing beneath the staircase looking up at the under side of it. Gaze steadily at the figure while imagining yourself doing this. You will shortly see that the figure is no longer the top but rather the bottom side of a staircase. Now, it is certain that the figure has not changed. What has changed has been your own response to the figure.

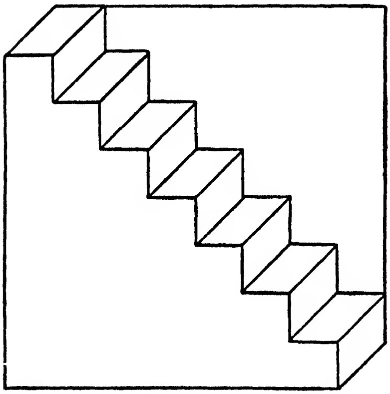

FIG. 45.—The staircase illusion.

Ernest Thompson Seton, in his book *Two Little Savages*, tells the story of some boys who were walking along a dark road at night. They suddenly saw what appeared to be a ghost in a near-by field. They, of course, ran until out of breath. Then one of the boys dared another to go back and investigate the ghost. The boy took the dare and crawled fearfully back to the field. As he neared the dreaded object, the moon broke through the clouds, revealing the fact that the "ghost" was nothing other than a white cow sleeping in the pasture.

Why did the boys see a ghost instead of seeing the object as a cow or as, perhaps, a white rock—which it might have resembled in the semilight? The reason is that the sensation was not clear and hence was capable of being interpreted in any one of the several ways

mentioned. The boys, on the other hand, were as most of us would be—in a frame of mind to think about ghosts—owing to the darkness of the night and the strangeness of the countryside. Being all ready to respond as they did respond if a ghost should actually have appeared, they used the cue, ran, and, since they behaved as though they had seen a ghost, they actually thought they saw a ghost.

Many of our perceptions are determined by these conditions of readiness to respond. Psychologists call these conditions "attitudes." The man who goes about with a chip on his shoulder has an attitude of pugnacity. He is actually holding himself in readiness to fight. Since he is ready to fight, he is, as we know, more than commonly inclined to interpret perfectly innocent remarks as a challenge. We say that such a person is "looking for trouble." Actually, his own responses are determining the perception growing out of the various sensations he receives. These facts are summarized by the psychologist in his definition of perception—*perception is sensation plus meaning*. We have seen that meaning grows out of the activity relating to any stimulus.

Perception and General Culture

Since perception is acquired meaning and since meaning grows only from activity, we may find a clue to the importance of general culture. A given object in our environment will have greater or less meaning for us, *i.e.*, will be more or less rich in culture, according to the degree of activity which we are able to carry out with relation to it. A painting will be meaningful to

a painter, because he will read into the painting all the activities of mixing paints and applying the brush strokes, which are necessary to produce the painting. The painting may also arouse verbal responses including the names of famous painters or the school of thought to which the given painting belongs. To an uncultured layman, on the other hand, the painting may have almost no meaning, because, although the same sensations enter through his eyes, he has not learned to make any responses to them. His response may, indeed, be limited to some such verbal expression as "Very interesting" or "I don't like the color of that sky." If the world of objects around us is to be meaningful and filled with rich perceptions, we must ourselves build up a background against which we may project these new experiences. Some travelers in foreign lands seem to get nothing from their trip except a series of perceptions relative to the quality of food served in the various hotels or the punctuality of the train service in the various countries. If the traveler gets nothing more than this, it is because his own field of life activity has been narrowed to eating and planning mechanical schedules for living.

The importance of habit formation and practice in determining correct perception has been startlingly shown by experiments in the field of tactual localization, in which is determined the accuracy with which a person may indicate the point on the surface of his skin which has been stimulated by the experimenter. The procedure involves having the experimenter touch the skin of the forearm of the subject and then having

the subject attempt to touch the same spot with his pencil. First of all, it is interesting to note that errors of as much as 2 inches are present in this form of an experiment. Older psychologists suspected that the degree of accuracy was related to the richness of the nerve supply under the given part of the skin. Peterson, however, showed that accuracy of localization was related to the degree of motility of the part of the body at which the sense organ is located. He found that accuracy of tactual localization was greater in the transverse than in the longitudinal plane in the case of the forearm, and he explained this by the fact that the arm is more easily rotated than it is moved forward and backward.

Renshaw continued this work by comparing children with adults as to accuracy of localization. If correctness of perception is, as we have said, related to experience or practice, one might at first suppose that adults would be better than children, since they have had more experience. As a matter of fact, however, he found children to be much the better. Renshaw explains this by the fact that children are learning to localize tactually, whereas adults have already passed on to a new and better method of localization, *viz.*, the visual. The truth of this fact is shown in the discovery that children do better with their eyes closed (average error 7.9 millimeters) than with their eyes open (average error 9.41 millimeters). Adults, having learned to depend upon visual localization, do better with their eyes open (average error 6.16 millimeters) than with their eyes closed (average error 10.37 millimeters).

Probably the most striking portion of Renshaw's study is the fact demonstrated by him—that among the blind the adults are much superior to children in tactual localization. This situation, which is just the reverse of that in sighted individuals, shows that blind adults have continued to *practice* tactual localization, whereas adults with vision have substituted visual localization. All these facts show clearly that tactual localization depends to a large extent on experience.

A standard psychological experiment offers an interesting illustration of the importance of tactual localization as it relates to the average adult's everyday adjustment. In this experiment a very simple form board is presented to a blindfolded adult. The adult is required to put the blocks of the form board into their proper places as quickly as possible. The board used is one which the average child can assemble in 4 or 5 seconds. Blindfolded, however, the adult finds that it will require as much as 2 or 3 minutes to assemble the board. This time is approximately equivalent to the time required by a very young child or a feebleminded adult when not blindfolded. The experiment illustrates the fact that the tactual perception of the average adult has not been trained. He is, therefore, in this respect at the level of a very young child or a feebleminded adult, the difference being, of course, that the normal adult could learn to perform problems in tactual localization with great skill, whereas the feebleminded adult could not.

Laird has suggested that we lose a great deal through being tactually blind, just as some persons lose much

through actual visual blindness. Many daily tasks such as manipulation of the driving mechanism of the automobile, the manipulation of writing implements on our desks, or the handling of utensils in the kitchen should be reduced to matters of tactual localization so that they could be carried on without a necessity of using vision. A person who loses his eyesight is immediately aware of this tremendous waste of potential perceptual cues. The apparently superhuman feats of many blind persons, on the other hand, are illustrations of what can be accomplished by the training of the tactual sense.

All that has been said should operate to make the student aware of the tremendous importance of training in connection with clear and complete perceptions. The psychologist says that we learn by doing. Each thing that we learn to do gives us, then, in addition, a more complete basis for understanding new sensations. The meaningful life is the life in which a person has actively responded to a wide variety of sensations. Such a person will have trained himself in all the possible motor responses of each sense organ. This is the true basis of the justification for what we call a "liberal education." It is true that a liberal education is valuable, because it enriches the personal life of the one so educated. Training in the arts and sciences, in literature, and in history may not operate directly in a dollar-and-cents way toward a person's betterment, but it does render him capable of reacting in a significant way to a wider variety of the experiences that may come to him. Every student should keep himself acutely aware

of this psychological truth in planning his own college career. Subjects should be taken that have almost no direct bearing upon one's vocation. The narrow-minded specialist is narrow-minded just because he has never learned to react to anything outside his own field.

Psychology and Aesthetics

The study of the psychological basis underlying aesthetic experiences affords a very interesting but only slightly developed field. As with a great many other problems in psychology, thinking about the nature of the beautiful tends to simmer down to one of two positions. The first is that certain forms or qualities are intrinsically beautiful. When analyzed, this statement probably comes to mean that we have certain innate tendencies to appreciate given forms or qualities. This, of course, is an outgrowth of an instinctivist attitude. The other point of view is that those things are beautiful which fit into certain patterns of appropriateness as they have been learned by each of us in our own life's experience. This second view would imply that anything whatever can be either beautiful or ugly, according to our own background of experience. Thus for us the mutilated and undersized body of a pygmy woman would be quite lacking in aesthetic appeal. We should not forget, however, that the unbecoming whiteness and lack of exaggerated ear or lip or nose lobes found in American women may be just as unappealing to the pygmies.

Empathy. Study of the principle of empathy can be used to help understand the operation of the second

explanatory principle of aesthetics. Empathy involves the concept of feeling with or projecting one's self into the situation observed. The most common example is that of viewing a building, the columns of which are either obviously too massive or too slender for their tasks. If the columns are too massive, a feeling of lack of balance results as if one were to visualize Atlas poised with muscles tense balancing a 6-inch globe on his hand. As we look at a building in which a massive superstructure is supported by spindly columns, we feel as if the columns are about to be crushed by the enormous weight above them. We project ourselves into the place of one of the columns and seem to feel our own person crushed under the impossible weight. Cartoonists use the principle of empathy when they picture the poor underfed and weak taxpayer (ourselves) staggering under an impossibly large burden of taxation.

The role of individual experience in connection with empathy may be illustrated by one's reaction in observing the construction of skyscrapers. Sometimes skyscrapers are built from the top down. That is, the steel skeleton is first erected and then the outside walls and furnishings are applied to the upper parts of the building first. Ordinarily this superstructure of completed materials supported by the slender steel girders at the base might give a feeling of lack of balance. As a matter of fact, most persons are so familiar with the actual strength and supporting power of steel that the situation comes to result in no unharmonious feeling whatever. In observing the construction of such a great project as Boulder Dam, one is, at first, shocked to see

a whole freight car carried across the chasm supported only by a slender wire cable. As one's experience grows and one's perceptual background comes to include an appreciation of the strength of the steel, the panorama provided by the enormous weight swung off in mid-air may actually come to provide an aesthetic experience of the highest type. Similarly, the sight of the mile-long span of the Golden Gate Bridge causes at first a shudder as one contemplates the slender cables supporting it and later an actual thrill at the beauty and balance of the whole structure.

Nature as a standard of comparison for things beautiful can be well understood in terms of our present discussions of aesthetics. Nature provides us with constant examples of balanced and adequate form patterns. This is because she does as a rule build well and efficiently. Our standards of rhythm and strength tend to be those forms for which we have the most common and most universal experience. We may visualize a future art (perhaps modern art is its beginning) in which our standards of beauty will no longer be the simple standards of nature but standards determined by engineering and other scientific knowledge.

Perception and the Senses

Visual Localization. The correct interpretation of visual sensations results from the cooperative action of a number of factors. The utilization of each of these factors is a result of learning. A few of these factors will be listed and discussed briefly:

1. Relative Size of Objects. We soon learn that the distance of objects from us can be gauged by their apparent size. We know that objects far away produce a small image on the retina, whereas near objects produce larger images. If we know the probable actual size of the object from past experience, we can judge its distance from us within certain limits.

2. Superposition of Images. From experience we learn that when the view of one object is partly shut off by a second object the first object is always farther away than the second. This seems so obvious that one is inclined to think of it as an instinctive or inborn perception. Such, however, is not the case, as can be shown from observation of very young children.

3. Clearness of Outline in an Image. Rays of light traveling through the atmosphere become gradually distorted owing to the action of particles of dust and other foreign matter in the air. Consequently, the farther away an object is, the less clear and definite will be its outline. We learn to use this fact in judging distance.

The preceding factors will be seen to be related to conditions outside the individual. The next factors to be mentioned are those relating to conditions within the body of the subject.

4. Convergence and Focusing. When both eyes converge upon an object, there is involved a movement of the eyeballs under the control of the six muscles controlling their movement. The kinesthetic sensations arising from these movements provide cues for the judgment of distance. If the object is near, the conver-

gence of the eyeballs will be great, and a strong muscular sensation will result. The extreme of this is a sensation of "crossing the eyes" when you look at the end of your nose. In a similar way the muscles controlling the lens of the eye must be active to adjust the lens for a clear focus. Again the muscular energy involved provides a cue for judging distance.

5. Binocular Vision. Probably the most important factor in visual perception is that of binocular vision. The fact of our having two eyes spaced approximately 3 inches apart makes possible the direct perception of their dimension or depth through cooperative action of the eyes. The way in which this operates is best illustrated by reference to the familiar stereoscope. In the stereoscope the subject looks through lenses at two pictures which are approximately the same. The stereoscope is so arranged that the right eye sees only the right-hand picture and the left eye sees only the left-hand picture. As a matter of fact, the two pictures on the stereoscope slide are not identical. The pictures are as different as they would be when viewed from positions as far apart as the two eyes are far apart. As a matter of fact, that is exactly the way in which the pictures are made. One picture is snapped from a given position; the camera is moved 3 or more inches and the second picture is snapped.

The judgment of depth comes, then, from a comparison of the two points of view. If the distance between the eyes were greater, the disparity between the two pictures would be more striking, and the impression of depth would be exaggerated. This may be accomplished

by an instrument called the "teleostereoscope." Looking at an object through the teleostereoscope gives the impression of exaggerated depth as it would be if the eyes were spaced 1 or 2 or more feet apart. The prism type of binocular, in which the lenses of the field are farther apart than the lenses of the eyepiece, helps in judging the relative distances in objects a great way off.

We all know that one of the greatest problems in motion pictures at the present time is that of obtaining a third-dimension effect on the screen. This has been accomplished by the use of a type of stereoscope device, but to date no one has been able to get the effect without special glasses for each individual observer.

The fact that the interpretation of these various cues depends upon learning was nicely illustrated by an experiment by Stratton. We all know that in normal vision the image is actually upside down on the retina. Since the images have always been that way, the individual experiences no difficulty in interpreting objects correctly. Stratton devised and wore a pair of glasses which reversed the light rays so that the image actually fell right side up on his retina. The result was that the world looked upside down. After wearing the glasses for a few days, however, he discovered that the world was gradually becoming right side up again. In a similar way at the close of the experiment when he removed the glasses, the world again appeared upside down for a time when viewed in the ordinary way.

In the next section we shall see many samples of illusions resulting from peculiarities in the operation of the factors we have just discussed.

Auditory Localization

Auditory localization results from learning to interpret some of the conditions similar to those just studied in connection with vision. Thus, sounds coming from a distance will be less clear than near-by objects and will be proportionately less loud. The ears themselves, however, unlike the eyes, are not adjustable mechanisms. Hence, the principle of binaural hearing will be more limited in scope than was the case with binocular vision. Experiments on auditory localization have shown that we can locate the source of sounds when there is a difference in what is called "phase ratio." Thus, if a sound is approaching from the right, it will reach the right ear with one part of the tonal pattern, whereas a different part of the tonal pattern will be getting to the left ear. If the sound be coming from a position exactly midway between the two ears, such differences in phase ratio are eliminated so that it is quite impossible to determine the origin of sounds coming from any median position.

To prove the cooperative function of the two ears in determining a source of sound, Young devised the pseudophone. This instrument carries sounds normally entering the right ear around to enter the left ear, and vice versa. As a result of wearing this apparatus, Young obtained the same reversal of apparent sound sources as was experienced in the visual field by Stratton.

In general, auditory localization is very much less accurate than visual localization. The fact that many people do not realize this has made it possible for un-

scrupulous lawyers to enter much information on the witness stand that would not stand the test of psychological investigation. Professor Munsterberg, in his book *On the Witness Stand*, gives many interesting examples of false testimony, sometimes given sincerely by persons who did not understand the possibilities for misinterpreting visual-auditory or other forms of localization.

Practical illustrations of the absence of accurate auditory localization is shown in the modern talking pictures. As pointed out elsewhere, we all know that the sounds do not come from the mouths of the characters on the screen. Nevertheless, we have no difficulty in perceiving the sounds as coming from that source. It is only when the sound is out of synchronization with the picture that we are made conscious of the fact that we ourselves are "mentally" putting the words into the mouths of the actors.

A more striking illustration of the same limitation of localizing ability is found in ventriloquism. Ventriloquists do not, of course, throw their voices. The illusion results from the fact that the ventriloquist speaks without moving his own lips, and at the same time causes his dummy's lips to move very obviously. We are so used to associating mouth movements with speech, and so poor in actual ability to localize sounds, that we fall easy victims to the ventriloquist's trick.

Localization in Other Senses

The performance of coordinated activities depends in large part upon sensations arising from muscles. This

involves a special form of kinesthetic perception. In other words, we must be able to interpret sensations arising from our muscles properly in order to carry on delicately coordinated activities. The typist carries out sequences of movement without any voluntary direction. This is possible because of the fact that each muscle action sets up a sensory stimulus that brings on the next movement in the sequence. It is because of this fact that typists are now taught to type, not letters or even words, but whole phrases or sentences as groups.

Closely related to the operation of kinesthetic perception is the operation of the sense organ of equilibrium in the ears. The semicircular canals are prime organs in determining bodily localization in space. The way in which these senses work together, as well as the way in which they cooperate with the other forms of sensory localization, is nicely shown in the experience of David G. Reeder, a friend of the writer.

Mr. Reeder, who is himself a psychologist, has published an analysis of his own experiences in adjusting himself to his loss of vision at the age of thirteen. After a period of reorientation, he became able to find his way about the house rather readily. He learned to move up and down stairs with considerable confidence. One day in descending the stairs he failed to use the banister. He progressed a few steps and then found himself falling to a heap at the bottom of the steps. He had not tripped and had had no impression of falling until he actually struck in the fall.

The explanation of this was found in the fact that the man had always suffered from a defect in the opera-

tion of the semicircular canals. So long as he had retained his sight, the defect was not noticeable, since he depended upon visual cues to maintain his balance and his upright posture. When the visual cues were lost, he of course had no way of knowing that he was falling. At the present, however, this man moves up and down stairways with as much confidence as any sighted person and without the aid of canes or the banister or any other artificial device. The secret of his success in this latter instance lies in the fact that he has now learned to pay attention to the kinesthetic cues which he had previously ignored. Now when he begins to fall, there is a sensation of stretching of the muscles of his legs and body in such a way that he becomes immediately aware of his loss of balance and can correct it. We see here the intimate relation of three separate varieties of perceptual responses.

Illusions

Since perceptions are defined as the attachment of appropriate meanings to objects, we may define illusions as inaccurate perceptions. A thing reacted to appropriately is said to be correctly perceived. In the same way, a thing that is reacted to inappropriately has been misperceived or has been seen as an illusion. There are three major causes of illusions.

Causes of Illusions. 1. Improper attention may cause illusions. We have already spoken of the sprinter who mistakes the order "Back up!" for the order "Go!" because he was "set" to go ahead. Attention is extremely important for efficient response to stimuli

in certain conditions, but it can be extremely dangerous in causing us to make improper responses in circumstances in which the nature of the stimulus is not well known. The highly prized faculty of open-mindedness comes to nothing more than refraining from a postural response until we have properly determined the full nature of the object.

2. Imperfections in sense-organ function result in illusions. Thus, if a person be suddenly deafened in one ear, his perception of auditory localization will become less accurate. Partial deafness accounts for a vast number of auditory illusions. Deaf persons try to hear what is being said and in trying usually take attitudinal responses. These being set off by partially heard sounds or words give rise to the common complaint of deaf persons that people are talking about them behind their backs.

In the field of vision we have a whole series of illusions resulting from the fact that the eye moves more easily in a horizontal plane than it does in a vertical plane. The stovepipe-hat illusion typifies these. The hat, to the normal eye, appears to be much taller than it is wide, although actual measurement shows its vertical and horizontal dimensions to be the same. The overestimation of vertical lines, which underlies the hat illusion is explained in part, at least, by the fact that the eye moves more easily on the horizontal plane than on the vertical. This can be demonstrated by moving the eye up and down between the points on the wall and then moving it an equal number of times backward and forward between two points in a horizontal position

on the wall. High buildings seem higher than they really are and also seem much larger than would buildings of a length equal to the height of the skyscrapers.

The fundamental factor operating here is that the eye muscles have become accommodated to horizontal directions because most of the visual world lies at the

FIG. 46.—The stovepipe-hat illusion.

same level as the observer. It is only in observing birds, airplanes, and the like that we elevate our eyes very much above the horizontal position.

3. Unusual conditions in the environment are probably the most common source of illusions. Each of the factors previously discussed under the head of Visual Perception offers a field in which visual illusions of this

sort can occur. Thus, in judging distance, it will be found that if the air is unusually clear mountains 60 miles away may seem to a visitor from a foggy region to be only a few miles off. Much of our normal visual perception is based on the fact that rays of light always travel in a straight line. In Fig. 47 if the observer *A* sees an object at position *B* in the street, he confi-

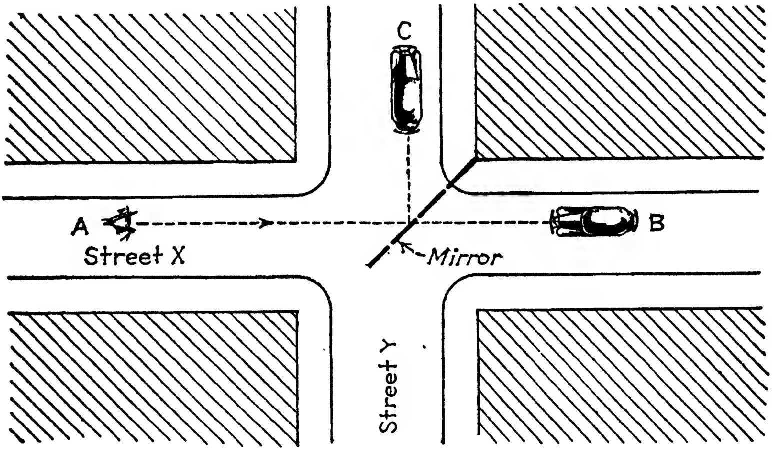

FIG. 47.—The illusion of position.

dently assumes that the object is actually at *B* and not at some other possible position *C*. Now, if some mischievous giant were to place a mirror diagonally at the corner as shown, it will be seen that the observer would be in error in assuming that the object was actually at *B*. The object is actually at *C*, but the rays of light coming from him are reflected by the mirror.

In localizing the sounds, we are less prone to be deluded by this kind of an illusion, since we all know that sounds may travel around corners.

The illustration of the object seen on the street in a position which it does not actually occupy is not entirely an imaginary one. Many of us have seen in side shows the illusion of the bodiless head, which is based upon exactly this principle. One finds the head apparently floating in mid-air. This head will talk, answer questions, smoke a cigarette, etc. Frequently the head seems to be sitting upon a table. Here the illusion is also perfect, since one can apparently see under the table in such a way that fraud seems impossible.

Figure 48 is a diagram showing how the illusion is created. All that is necessary is to have a large plate-glass mirror placed diagonally across the lower corner of the room. The "bodiless" persons sits with his head sticking through a hole in the mirror. Now, the walls and floor of the room are furnished in the same color. Thus, the rays of light from the ceiling are deflected, as shown by the dotted lines in the figure, so that what is actually seen in the mirror is the ceiling of the room. But, since the ceiling is the same color as the walls, one interprets the color seen as being the wall of the back of the room. If the mirror is of fine quality, the illusion cannot be escaped, even though one knows the nature of the trick.

A simpler illustration of the same distortion, resulting when light, which usually travels in a straight line, is caused to bend, is to be found in the disappearing-coin trick. Let a basin be placed on the floor a few feet in front of the subject and a coin placed in it so that the edge of the basin hides the coin. Now, the experimenter can cause the coin to appear without touching either

the coin, the basin, or moving the subject. All that is necessary to accomplish this is to pour some water in the basin, whereupon the rays of light passing from the coin will be bent slightly so that the coin will be in clear view. Illusions of this kind are not uncommon and have many industrial as well as amusement uses.

Illusions resulting from the abnormal function of the binocular character vision include the famous "floating-

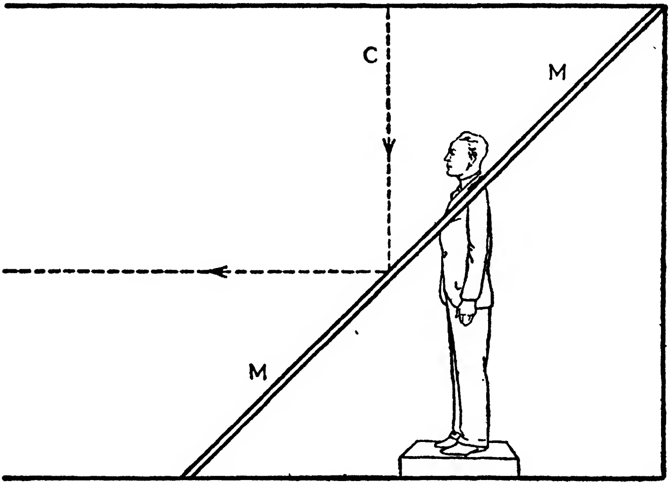

FIG. 48.—The bodiless-head illusion.

finger" illusion. If the student will fixate on a point of the wall of the room and then will hold the two index fingers pointing toward each other, as shown in Fig. 49, and will elevate them into his line of vision, he will enjoy a startling illusion of a separate, unattached finger floating in mid-air. Analysis shows that the illusion arises from the fact that the eyes, being focused on a far object, see near objects double. Because of the proximity of the two fingers, the innermost of each of

the double images overlap. This overlapping gives a reality to the secondary image which causes the illusion. These secondary images are ordinarily ignored, because, being single, they are fainter than the objects in focus.

Illusions of Movement. Among the illusions none, perhaps, is more interesting or important than the *phi* phenomenon, or the illusion of movement. If two lights be placed at a distance of 6 to 12 inches from each other and are then illuminated alternating at a proper rate of speed, it will be found that, instead of seeing each light going on and off, one will seem to see one

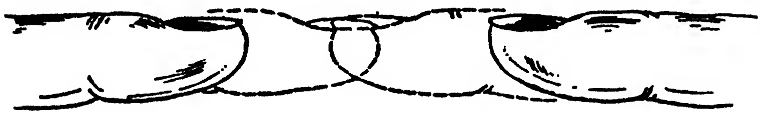

Fig. 49.—The floating-finger illusion.

light moving back and forth between what one knows to be two independent sources of illumination. In other words, *we perceive* movement where there is no movement. The illusion of movement can be obtained in a great variety of patterns and time relationships depending upon the intensity of the stimulus, the distance between the points of stimulation, and the rate of fluctuation. For our purposes it is important to notice that illusions of movement are fundamental to at least two practical enterprises in modern life. They are animated or moving advertisements and motion pictures.

In the case of moving advertisements the development of the neon tube made possible the controlling of the rate of fluctuation of light so that, as we drive

through towns nowadays, large numbers of signs seem to exhibit movement. We may see animals apparently running across the country, arrows darting backward and forward pointing to places of business or, more commonly, designs that seem to chase themselves around the borders of motion-picture theater signs. In our study of the factors of advantage in attention, we shall learn that movement is one of the most potent. When movement is accompanied by intensity and color, as it usually is in the case of neon signs, we have a series of factors of very compelling attention value.

Most of us have learned in our high-school physics courses that motion pictures actually do not move at all. Not only do they not move but, as a matter of fact, the screen is not even illuminated continuously by the pictures. Not many of us realize the fact that, when we sit in a movie, we actually gaze at a blank and totally dark screen during a considerable fraction of the time. This is because motion pictures consist actually in a rapid series of still pictures flashed upon the screen. The carry-over from one picture to the next is, in part, a function of positive afterimagery based upon the lag in chemical reactions in the retina of the eye. The apparent movement comes from the fact that each picture shows the people, cars, etc. in slightly different positions from that in the preceding one. The movement then is not in the picture at all but is supplied by our own minds, just as the movement between two points of light in the original *phi* experiment is provided by our own minds. The operation of the *phi* phenomenon in motion pictures is best shown, perhaps, by the little movies which as school

children we all used to draw in the corners of our books. Little men and women were drawn in skeleton outline on successive pages of our books. In each picture the position of the arms and legs would vary slightly. When the pages were flipped rapidly, we were amused and delighted to see our mannequin waving his arms or dancing about.

Practical Uses of Illusions

Visual and other illusions are extensively used with the conscious purpose of "making things seem what they are not." One of the most important uses of illusions is the science of camouflage in which ships are caused to blend with the surrounding water or are made to seem to be going backward so as to ruin the aim of submarines in firing torpedoes. Camouflage is used in land warfare to hide guns or to suggest the presence of guns, as well as to disguise either the presence or functions of airplane hangers, munition dumps, or other centers of activity. From such highly technical uses of illusions, we can shift to their use in making bottles of goods seem larger than they are or to intermediate uses in making buildings seem larger or different than they really are. In the case of buildings it is possible to use the illusion of perspective to make the roof of a building seem much higher than it is by judiciously reducing the spacing between shingles as the ridge of the roof is approached. A friend of the writer caused a rather narrow hallway in his house to appear much larger than it really was by painting it a deep blue with brighter colors used in adjacent rooms. The principle here was

that the brighter colors such as yellow and white are more space filling, owing to the principle of irradiation, than are the darker colors such as the blue used.

In addition to the use of the *phi* phenomenon in advertising many other illusions are utilized. Apparent three-dimensional effects are obtained on billboards by proper arrangement of light intensities and by the painting of back drops. Startling three-dimensional effects are obtained by introducing a very small amount of actual third dimension as by placing a few cardboard figures 5 or 6 inches forward from the general painted background of the billboard.

Visual illusions are constantly used to excellent advantage in tailoring. The vertical-horizontal illusion as studied in connection with the stovepipe hat has more pertinent applications in planning clothing for stout men and women. By using a vertical striped pattern, emphasis is placed upon height and stout people are made to seem taller and more slender than they really are. Conversely, we stand aghast sometimes when we meet a tall slender person who has made the mistake of buying a striped suit with the result that he appears almost a human skeleton. Using the principle of illusion that filled spaces seem larger than unfilled spaces, thin persons will do well to wear figured clothing or brightly colored clothing whereas stout persons should tend more toward plain designs and dark colors. Another simple example of the proper use of the vertical-horizontal illusion would be that stout persons should avoid bow ties in favor of four-in-hand ties, particularly narrow ones.

Illusions in Packaging. Somewhat extensive work has been devoted to the use of illusions in making containers seem to hold more than they actually do. A variety of methods may be used here, each of which goes back to one or another of our basic types of illusion. Paper boxes that are tall and narrow seem to contain more than ones that are wide and low. This same vertical-horizontal illusion operates in glass bottles so that tall tapering bottles seem deceptively large. Olive oils, salad dressing, and other commodities that are distributed in relatively small quantities frequently make use of this situation. An interesting problem confronted distributors in effecting the shift from glass bottles to tin cans as containers for beer. The glass bottle with its tall tapering neck seems to contain a great deal more liquid than does the squat beer can. One of the major can companies went to a rather great and otherwise unnecessary expense in putting a cap top on its can so as to retain some of the illusion of the bottle. The competing concern frankly abandoned the bottle technique, lost the advantage of the visual illusion, but played up certain other advantages including a new type of opener. It is interesting to note that in the latter case, the can states the number of ounces contained with this emphatic addition, "Same as in the bottle." The principle of filled versus unfilled space is put to good use by a certain cereal company in packaging its goods in a black-and-white figured pattern. This figured pattern makes the box seem much more bulky. In the same way bright-colored boxes have an advantage over others. Shaving creams and tooth pastes are

prudently marketed in gay yellow or other bright-colored tubes in which considerable study has been given to the relative diameters and lengths of the tube. In general the tube should be just as long and slender as it can be without actually appearing spindly. At least one tooth-paste concern has used the principle of stripes on its tubes to increase their apparent size.

Redintegration

We have seen that in the case of perception the sensation becomes meaningful only when it has given rise to a more or less adequate response. Now, one of the interesting abilities of a human is to respond to a fragmentary part of what was originally a complete sensory experience. Thus, the baby soon learns to respond to its mother's voice as it did to the actual presence of the mother. Even dogs can recognize their masters' footsteps. In these cases the perceptual response is based upon a symbolic stimulus. We have already defined a symbol as some object standing for something other and usually more important than itself. The process by which a fragmentary part of an experience can set off the complete response is called "redintegration." Redintegration accounts for a large part of human activity. We should be quite unable to carry out the complex behavior that characterizes us were it not for this situation.

Signs, flags, facial expressions, and gestures are all examples of these limited stimuli. The whole phenomena of speech, as well as the written word, center around symbolic stimuli. In other words, the written letters,

having no intrinsic meaning, nevertheless may set off human responses of the most important nature.

Marginal Functions of Redintegration. In addition to the normal uses of symbolic stimuli, we find redintegrative responses active in creating illusions and certain other hard-to-define mental experiences. Hunches and intuition are examples of these. When a person says he has a hunch that something is going to happen, we can usually establish the fact that the hunch results from some slight ill-defined stimulus. Had this stimulus been more definite and observable, the reason for the person's belief would not be at all difficult to understand. In the same way, intuition is not a direct arrival at knowledge through a mystical mental process but is rather the arrival at a conclusion or a point of view as a result of the operation of stimuli of which the person is unaware.

The vague sense of familiarity, which gives rise to what is sometimes called the "already seen—never seen" illusion, has an identical basis. Each of us has at one time or another met a person whose face seemed "strangely familiar." Every effort to establish an earlier acquaintance with the individual may fail, but the sense of familiarity still remains. Redintegration may be operating in this case in one of two ways. In the first place, some one feature of the individual may closely resemble the same feature of a person actually known. Thus, reacting to the one trait, we get a perceptual response of familiarity to the entire person.

The same thing occasionally happens with relation to inanimate objects. One may drive into a town that

he has never before seen and be struck with a powerful impression that he has previously visited the place. The two towns may be much different in detail, but they exhibit certain fundamental similarities.

Vague likes and dislikes frequently have the same origin. One may meet an individual for the first time and be struck very favorably or very unfavorably by this first contact. One is usually at a loss to explain this negative reaction. A popular jingle puts it like this:

> I do not love thee, Doctor Fell,
> The reason why I cannot tell;
> But this alone I know full well,
> I do not love thee, Doctor Fell.

The reason the individual did not like "Doctor Fell" is simply that "Doctor Fell" resembles in one or two particulars some other person whom the observer had a very good reason to dislike. The observer will usually be unable to identify these elements upon which the unfavorable reaction hinges.

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Appendix A

THE BASIC MECHANISMS OF ACTION

Development of Specialized Structures

We have already seen that even simple unspecialized organisms are capable of carrying on fairly complex reactions. We learn from this that the complicated receiving and reacting mechanisms found in man are not essential to the carrying on of adjustment activities. Indeed, the process of growth and evolution of the specialized structures may be followed through from the lower to the higher forms of life. Parker has shown that the order of the development of the specialized structures involved in the simple reaction unit is not that of the order in which they function. In the more elementary forms of life the same structure acts as both receiving mechanism and reacting mechanism. It is as though the muscle both received and reacted to a given stimulus. This, indeed, is true of even more elaborate structures. Human muscle tissue may be directly stimulated by electrical or chemical irritants and will respond by appropriate contraction. Parker found that the first step in the specialization of structures consisted in the development of receptor cells. These were usually located

either among or near the muscle cells. It was the function of these receiving cells to be irritated by changes in the environment and, by transmitting an impulse to the muscle cells, to set them in action. As the evolution process continued and the organisms became larger, it was frequently necessary that the receiving mechanism be located at a considerable distance from the muscles, and a third type of specialized cell developed. These are called "connector cells." These structures, which are very simple in lower forms of life, have become more and more elaborate, until the connecting mechanisms now constitute, in humans and other higher animals, the very complicated nervous system. Parker has shown that, whereas the order of functioning of a reflex arc is receptor-connector-effector, the order of its evolutionary development was really effector, receptor, and connector.

In order to study the mechanisms by which a simple reaction is carried out, it is necessary to refer briefly to the structures and functions of the parts of the reaction unit. We must not think for this reason that these parts ever function independently and without relationship to the other parts. They do not. It will facilitate study, however, to consider them independently.

The following is a classification of the structures making up a reaction unit:

A. Receptors. These include the specialized cells of the various sense organs. They may be classified as follows:

1. Exteroceptors, or cells receiving stimuli from outside the body

2. Interoceptors, or cells receiving stimuli from internal cavities of the body, such as the stomach, intestines, etc.
3. Proprioceptors, or cells receiving stimuli from within the body tissues themselves
4. Nociceptors, or pain receptors

B. Connectors, or nerves communicating from the receptors to effectors:

1. Sensory or afferent nerves
2. Central nerves, those lying entirely within the spinal cord and brain
3. Motor or efferent nerves

C. Effectors. These are of two types:

1. Muscles, which in turn are of two muscles
    a. Smooth (typically involuntary)
    b. Striped (typically voluntary)
2. Glands, also of two types
    a. Duct
    b. Ductless or endocrine

Effectors—Muscles

Muscles are cells specialized to the function of contraction. They normally contract as a result of a nerve stimulus. They may respond, however, to other kinds of stimuli. Chief among these *nontypical stimuli* are:

1. Electrical current, which as we shall see bears a close resemblance in many respects to nerve current.

Exercise: The way in which electrical current can cause contraction of the muscles of the forearm may be demonstrated by means of directing an electric current into the middle of the forearm and out through the

wrist. Under these circumstances the fingers will close involuntarily, and the subject will be quite incapable of straightening them out.

2. Chemical stimuli may cause muscular contraction as when a bit of salt comes in contact with an exposed muscle tissue and results in vigorous contractions.

3. Muscles may be stimulated mechanically; thus an exposed muscle will contract if pricked with a pin or pinched with tweezers.

There are two kinds of muscles, smooth and striped. Muscle cells are true living cells, each with its nucleus and other cell parts. Upon appropriate stimulus the muscle cell changes its shape, increasing its circumference and decreasing its length. In the smooth muscle tissue the cells appear flat, as though they were flagstones in a pavement. Smooth muscle tissue is found in the linings of the various cavities of the body, such as the walls of the stomach, the intestines, the veins, and the arteries. Smooth muscle tissue is under the control of the autonomic system and is hence involuntary in function. Striped muscle tissue is under the control of the cerebrospinal or voluntary system for the most part and makes up the large muscle groups that move the limbs and perform the other gross bodily actions. Muscle cells are to be found in large groups or bundles. These bundles are supplied by motor nerves that transmit impulses to them.

By means of a nerve muscle preparation, we may study the functions of muscles. After a frog has been killed, one of the large voluntary muscles of its leg may be removed together with a portion of its motor

nerve. If this muscle be attached to a long lever marking upon a kymograph, the muscle may be stimulated, and the nature of its responses studied. If a single stimulus is applied, it will be found that the muscle makes a single spasmodic contraction. This is called the "phasic contraction." It is not the typical form of muscle action, in either smooth or striped muscle. If now we control our stimuli so that just as the first or phasic contraction reaches its maximum we send a new impulse into the muscle, we find that, instead of relaxing, the muscle will contract still further. This is called the "summation effect." If stimuli are sent into the muscle at such a rapid rate that the muscle at no time is enabled to begin its relaxation, then the muscle contracts to its highest point and remains contracted so long as the impulses continue to arrive or until such time as fatigue sets in. Such a contraction is called "tetanic contraction" and represents the type of contraction almost universally observed.

Effectors—Glands

The second main group of effectors are glands. Glands, like muscles, are of two types. The first are the duct glands. Duct-gland secretions are passed by means of little tubes to either internal or external surfaces of the body. Examples of the duct glands are the salivary glands in the mouth, tear glands in the eyes, and the sweat glands on the surface of the skin. The second main class of glands is the ductless or endocrine glands. These glands produce complex chemical substances called "hormones," which they secrete directly

into the blood stream. They are, of course, immediately carried to all parts of the body by the blood stream.

The detailed study of glands is properly a field for physiological work. Their influence upon psychological functioning is so significant, however, that it will be desirable to mention a few of the more important of the endocrine glands.

Thyroid Gland. Probably more is known about the thyroid than about any other endocrine gland. The function of the thyroid gland seems to be that of releasing iodine into the system. Where iodine in the water or other sources is limited, the gland tends to become enlarged. As a result of this enlargement and overactivity, certain secondary results are observable. An enlarged thyroid gland is commonly known as a goiter, and the condition resulting from it is called exophthalmic goiter. The general picture here is one of increased bodily metabolism. Nervousness, rapid pulse, loss of weight, and protruding or staring eyes are among the symptoms. The reverse of the exophthalmic condition is found in a disorder called cretinism when it occurs in children and myxedema when it occurs in adults. These conditions of underfunctioning of the thyroid result in a low rate of metabolism with a consequent tendency to build up fatty tissue and with a resulting loss in muscle tonus which gives the individual a flabby external appearance. Victims of this disorder are sluggish, indifferent, and, in some cases, so deficient in intelligence as to be classified among the feebleminded.

Thyroxin, which is the active principle of the thyroid secretions, can be prepared artificially in the laboratory

and may be administered under medical supervision to persons deficient in thyroid. Many truly remarkable improvements have been brought about in this way. Unfortunately this treatment must usually be continuous if the symptoms are not to reappear.

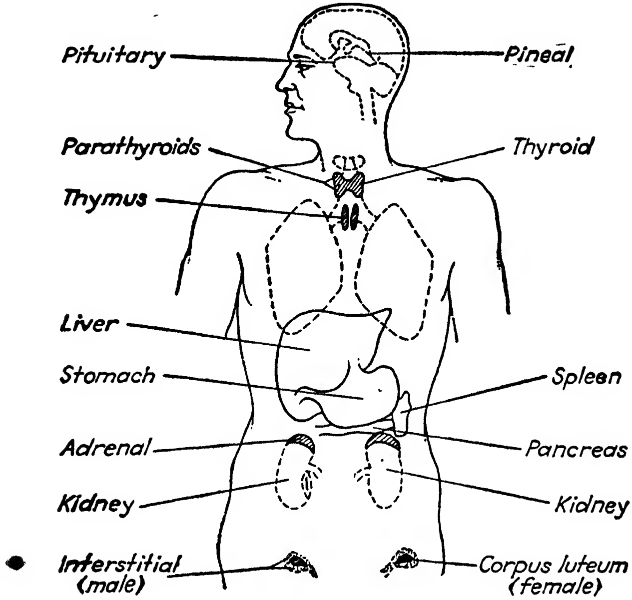

FIG. 50.—Location of the principal endocrine glands.

The parathyroids are small glands embedded in the thyroid. Their function seems to control calcium metabolism. Calcium is known to have a regulating effect upon tissue in such a way that when it is lacking, as in the removal of the parathyroids, convulsions and other extreme nervous disorders result. These frequently are so severe as to cause death.

Pituitary Gland. The pituitary gland is a very small gland found at the base of the brain and has important

functions relating to the sexual development and the growth of the individual. Oversecretion of the pituitary gland leads to gigantism when it occurs in early life. When it occurs after the bones have set in adulthood, a disorder called acromegaly results. Here there is a general increase in body mass which, since it is not accompanied by skeletal changes, results in a peculiar massive, puffy appearance in the person affected.

Pineal Gland. This gland is not well understood but is believed to exercise an inhibitory influence upon sex functions. At any rate, it tends to become inactive at adolescence. As a result of this inactivity, pubescence and the development of definite sex functions appear. Where the pineal gland becomes inactive at too early an age, we find premature appearance of sex traits. If its function continues too long delayed adolescence results.

Sex Glands. In connection with the function of the pineal gland, mention should be made of the endocrine functions of the sex glands. The sex glands function both as duct and as ductless glands. As duct glands they produce, respectively, the ova or female egg cells and spermatozoa or male cells. As endocrine glands they produce hormones that regulate the appearance of secondary sex characteristics. The appearance of these secondary sex characteristics marks the onset of puberty. In the male they involve such things as the change of voice, appearance of the beard, and a general increase in stature and firmness of structure. In the female corresponding changes occur in the form and development of bust and hips and changes in proportion of various parts of the body. It should be noted here that the

failure of the endocrine functions to appear results in a partial absence of the secondary sex characteristics. In its more complete absence the result is the neutral type or "sexless" person. Probably some sexual abnormalities such as homosexuality have a physical basis of this sort, although it should also be remembered that they frequently have a purely social origin.

Adrenal Glands. The adrenal glands are among the most significant as far as their psychological effects are concerned. In general the secretion of adrenalin into the blood stream has a result similar to that of the thyroid except that the effects are more immediate, of much greater intensity, and of shorter duration. Specifically the presence of adrenalin in the blood stream results in a speeding up of the heart, a quickening of the rate of respiration, and a rise in general muscle tonus. The general effect is that of increased readiness to carry out physical activity. Internal changes that also fit into this picture are the release of blood sugar from the liver to provide immediately available energy and a change in the direction of the main blood flow from the internal organs to the arms, legs, and gross striped muscles. Blood in which adrenalin has been injected shows a much more rapid rate of coagulation than it does otherwise, so that blood tends to clot more quickly in wounds. The importance of this in case of struggle is obvious. The second effect is that, when the blood containing adrenalin bathes the muscle tissue, it tends to reduce the onset of fatigue. We have seen elsewhere that fatigue results from an insensitivity of the muscles owing to the presence of carbon

dioxide and other fatigue products. Apparently adrenalin overcomes this by increasing the basic sensitivity of the muscle so that it can force itself beyond its normal fatigue point. Naturally such a forcing of the muscle will result in more or less serious aftereffects, but, in the case of an emergency situation, it may provide the necessary energy to carry out a successful physical struggle.

An illustration of the fairly direct relation between endocrine gland function and certain psychological reactions is afforded in some recent work of Crile and McCullagh.[1] These investigators have been working with a disorder called "soldier's heart," in which the heart exhibits changes in function similar to those during stage fright. The similarity between the fear stimuli to which a soldier is exposed and the less drastic stimuli that give rise to ordinary stage fright will be evident. Crile and McCullagh found that these disturbances could be successfully treated by severing certain nerves relating to the control of the adrenal glands. By thus preventing an overactivity of the adrenal glands they were able to improve or cure 119 out of 127 cases of "soldier's heart." Here we have an instance of a successful treatment of a psychological disorder through artificial regulation of endocrine secretion.

A Word of Warning. The influence of the endocrine glands upon physical growth and also upon personality and temperament is very great. Science is advancing rapidly in this field so that, as we have suggested, in many cases it is possible to overcome undesirable effects

[1] Reported in *Newsweek*, Oct. 14, 1940, p. 56.

of the malfunctioning of glands by the feeding of glandular extract. It is of utmost importance in this connection that every person understand that glandular therapy is one of the most difficult and, in the hands of anyone except experts, one of the most dangerous fields of medicine. Unfortunately a great number of actual quacks have entered this field to the point where one can turn to almost any magazine or Sunday paper and find many advertisements for gland treatment. Unless one is absolutely certain of both the integrity and medical training of one's practitioner, it will certainly be extremely unwise to undertake any form of glandular treatment. This work, which is so filled with possibilities for both good and bad consequences, should be carried on only by the highest type of physician.

Receptors

The receptors or sense organs are structures that are especially designed to be aroused by changes in the environment. They are necessary for the reason that it is desirable for the organism to come in contact with varied aspects of the environment. Psychological interest in the sense organs centers around the functions of sense organs rather than in a study of their structure as such. A study of the receiving mechanisms has been taken up in connection with a study of their functions in the chapters on sensation.

Connectors

The more distant points of the organism are kept in communication with each other by means of specialized

cells called "connectors." These connectors, together with specialized cells of the receiving apparatus, constitute the nervous system. The unit of the nervous system from a structural standpoint is the individual neuron. Figure 51 shows a typical neuron. The dendrites are short projections from the cell-body which are sensitive to changes going on around them. They are

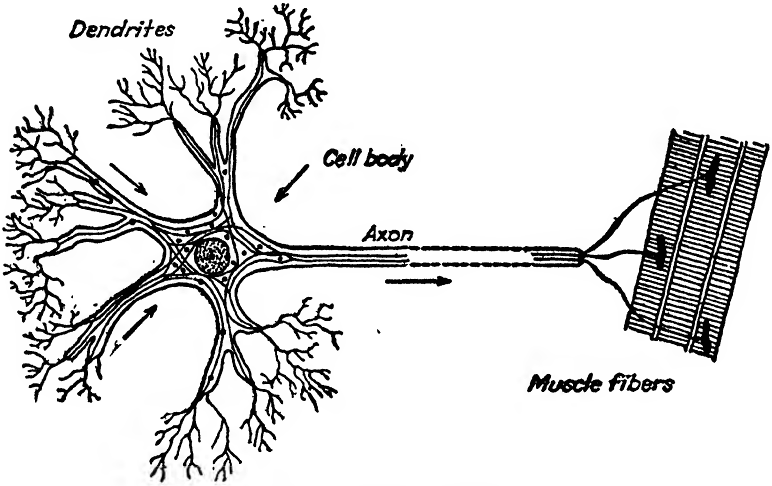

FIG. 51.—A motor neuron.

the receiving part of the neuron, and impulses to be passed along by the neuron enter through one or more of these dendrites. The cell-body from which the dendrites grow does not differ materially from the cell-bodies of unicellular animals. It contains a nucleus, together with the protoplasmic matter, which carries on the vital function of providing nourishment for the rest of the cell. The long slender protrusion from the side of the cell-body is the axon. This is a slender shaft of matter, silvery in color, and varying in length from

3 or 4 feet in extreme cases to as little as a fractional part of a millimeter in the case of some of the central neurons.

The axon is usually insulated from surrounding tissue by means of a sheath. If this sheath is broken by accident or by disease, there may be a short-circuiting of the current, just as there may be in the case of electrical wiring. At the extreme end of the axon we find a small branching of the fiber in what is called the "end brush." The impulse passes from the end brush to the dendrites of the next neurons in line or, in the case of motor neurons, to the fibers or glands of the reacting structure.

The exact nature of neural function is not known. It is known that the stimulus releases energy stored up within the nerve cell. In other words, the nerve cell does not merely transmit energy that is passed to it; rather it is set going by the stimulus and provides its own energy, which it passes along to its end brush, where the energy released from the end brush in turn stimulates the next cell to action.

The nature of nerve current is analogous in many ways to electrical current. In so saying we must remember that we do not even know the nature of electricity. We do know some of the things it will do and some of the instruments that will record it. This is precisely what we know about nerve energy, and we say that it is similar to electricity because it can be measured on the same instruments that are used to measure electrical current. The neural impulse is not transmitted along the neuron at the tremendous rate at which

electricity travels; in fact it travels at the rate of only about 394 feet per second. It is also known that the propagation of the nerve impulse involves a progressive chemical reaction. The stimulus arriving at the dendrite sets up a metabolic change which is accompanied, as has been shown by Professor Hill in England, by the release of heat and carbon dioxide.

The student can get perhaps the best idea of the nature of neuron action by comparing it with the burning of a fuse. The application of the match to the end of a fuse sets going a chemical change called combustion, which burns its way along the fuse until it reaches its distant end. If one could imagine a dynamite fuse having the ability to reestablish itself so that it might be reignited, one would have a very fair picture of the nature of nerve action. The electrical analogy of the nervous system can perhaps be better understood when we remember that both storage batteries and dry cell batteries release electrical energy through chemical changes going on within themselves. Professor Adrian of England has probably done more than any other scientist to study the exact nature of the electrical currents that pass over neurons. He is chiefly responsible for the scientific proof of the all-or-none principle as applied to nerve action. Nerves, like muscle fibers, are rarely, if ever, found isolated. They almost always constitute bundles of individual fibers. Professor Adrian has been able to subdivide these nerve bundles until he has obtained very small groupings of them. Then by means of a very delicate recording apparatus he has photographed the actual electrical

changes that pass over the nerve fibers. He has shown that when a nerve is discharging strongly it is discharging a rapid series of impulses and that when it is discharging weakly it is discharging a slower series of impulses. In other words, each time that the individual neuron discharges, it discharges its total amount of energy. If we remember the nature of tetanic muscle contractions as discussed above, we shall see that the individual fiber discharging into its own group of muscle fibers will produce a state of partial or complete tetanus, depending upon the rate of discharge and the number of muscle fibers affected.

Functions of the Lower Levels. Our present knowledge of the nature of nerve function began with an understanding of the structures involved in reflex acts. We have already stated that the structural unit of the nervous system is the neuron. The functional unit on the other hand is the reflex arc. The reflex arc represents the minimum amount of structure necessary to carry out even the simplest act. Such a reflex arc must contain at least the following structures: (1) a receiving structure, (2) an afferent or sensory neuron, (3) an efferent or motor neuron, and (4) a motor or reacting structure. With such a minimum of structural equipment, it is possible to carry out a simple act. This structure is called the "neural" or "reflex arc." It was Descartes, the famous French philosopher, who first conceived of action as resulting from the passage of an impulse to the brain and back again to the appropriate structure. Later studies proved the correctness of his basic idea, by discovering that the cutting of nerves results in

loss of power of movement. Further studies have resulted in an understanding of the function of the spinal cord in this connection. Hall learned that if the dorsal of the two branchings from the spinal cord were cut, a loss of sensation resulted and that if the ventral of the two routes were cut, a loss of motor power resulted. If the nerve were cut at a point before it branched, both sensation and motor power were lost.

The spinal cord consists of two types of structure. The central butterfly-shaped area of gray matter consists in the cell-bodies of motor neurons together with their dendrites and the end portions of the incoming sensory neurons. It is, therefore, in the central gray matter part of the cord that the synaptic, or neural, connections occur. All nervous impulses entering the cord pass through the gray matter. The outside portion of the spinal cord is called the "white matter" and consists in the axons of nerves. These axons carry impulses up and down the spinal cord so that sensations entering at one level in the cord may result in action at another level or, in many cases, the impulses entering the cord at any given point may be carried to and from the brain.

The operation of the central or gray-matter area is shown in connection with the dreaded disease, infantile paralysis. In this disease the gray matter of the ventral horns is attacked by disease germs as shown in Fig. 53. Since this disease destroys the cell-bodies of the motor neurons that lie in this area, the motor neurons die from lack of nourishment. The result is that impulses enter the spinal cord from the dorsal side but cannot pass out over the ventral side; consequently, a complete and

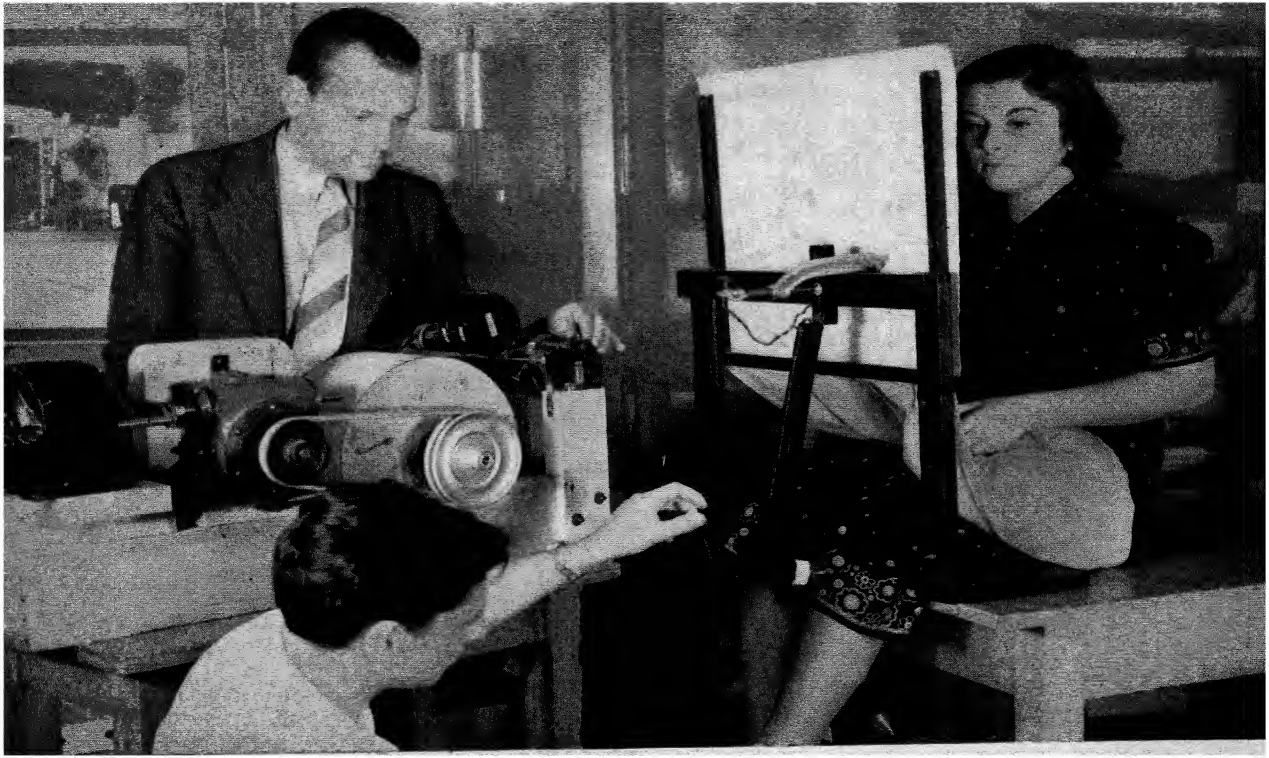

FIG. 52.—*Measuring the knee-jerk reflex.*

(*Facing p. 448*)

permanent paralysis of the areas served by these nerves results. An illustration of the way in which the human system can adapt itself is offered in the process of training that science uses to overcome partially this paralysis. The training consists largely in attempting to get a certain radiation of impulses from any few motor fibers that may remain so that they stimulate more muscle fibers than they previously did and, secondly, in training remaining healthy muscles to take over the functions of the paralyzed muscles. Incidentally this disease illustrates the fact that a healthy muscle is always in a state of partial contraction. Where the nerve supply is completely eliminated, as in some cases of infantile paralysis, there results complete flaccidity or absence of tonus. When this occurs the muscle wastes away through a process called "atrophy through disuse."

The white matter of the spinal cord is divided up into a complicated pattern of pathways; some carrying messages up the cord (sensory impulses), some carrying messages down the cord (motor impulses). It is not necessary for our purposes to study the organization of these paths in detail. Their operation can be well illustrated, however, by the effects of a disease that attacks the white matter. This disease is locomotor ataxia. In locomotor ataxia the white matter in the dorsal area is destroyed as shown in Fig. 54. This area is made up of sensory fibers that bear for the most part kinesthetic sensations or those relating to the feelings resulting from the movement of muscles. A great many of our coordinated activities result from these kinesthetic sensations. Consequently when the system is deprived of them, the

individual becomes unable to move in a steady and balanced way. The disorder gives the appearance of the person being paralyzed or unable to control his movements on the motor side. As a matter of fact, however, the motor side of his functions may be normal but he cannot control his movements because he cannot "check up" on the nature of the muscular contractions that are occurring. In walking he may lift his feet entirely too high or he may lift them so slightly as to stumble. In

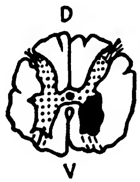

FIG. 53.

FIG. 54.

FIG. 53.—Destruction of gray matter in infantile paralysis.
FIG. 54.—Destruction of white matter in locomotor ataxia.
(*From Franz and Gordon.*)

some cases the only way in which the patient can walk successfully is by watching his feet constantly to see where he is placing them.

Destruction of axons in the case of locomotor ataxia illustrates the effect of destroying sensory paths through the white matter. Other disorders result from the destruction or atrophy of motor pathways through the white matter. When these "pyramidal tracts," as they are called, lose their function, various types of paralysis occur. The two diseases mentioned are sufficient to illustrate something of the functioning and the complexity of the organization within the spinal cord.

Functions of the Higher Levels of the Nervous System. Certain simple processes may be carried out at a purely

spinal level even though the brain be missing. Thus, the withdrawal reflex in the frog can be aroused even though there remains but a small section of the spinal cord. Most action, however, and probably all voluntary action in the higher animals depends upon the presence of the higher nerve levels. Animals such as the dog cannot live without the midbrain. Man usually dies as a result of the destruction of large portions of the cerebrum, although there are exceptions to this. It is apparent, therefore, that the higher levels of the nervous system are essential to the carrying out of the higher functions of the organism. The central nervous system may be divided into four parts: (1) the spinal cord with its roots, (2) the brain stem including the midbrain, made up of medulla oblongata and the thalamus, (3) the cerebellum, and (4) the cerebrum. In mammals the cerebellum seems to be particularly involved in what are commonly called instinctive activities and in the regulation of certain automatic or involuntary processes, especially those related to tonus and to muscle coordination. The thalamus, which represents the uppermost part of the midbrain and the point at which it branches into the cerebrum, is an important structure from the standpoint of psychology. In the first place, all sensory impulses, with the exception of the olfactory, must pass through it before arriving at the cerebrum. It is important, secondly, because of its function in controlling the processes involved in emotions. This function will be studied more in detail when we turn to a study of emotional activity.

Structure of the Cerebrum. The structure of the cerebrum may be most easily studied by reference to Fig. 55 which shows the main divisions of the cerebrum together with the chief functional areas as they have been discovered. The cerebrum consists of two hemispheres that are completely separated except for a great band of

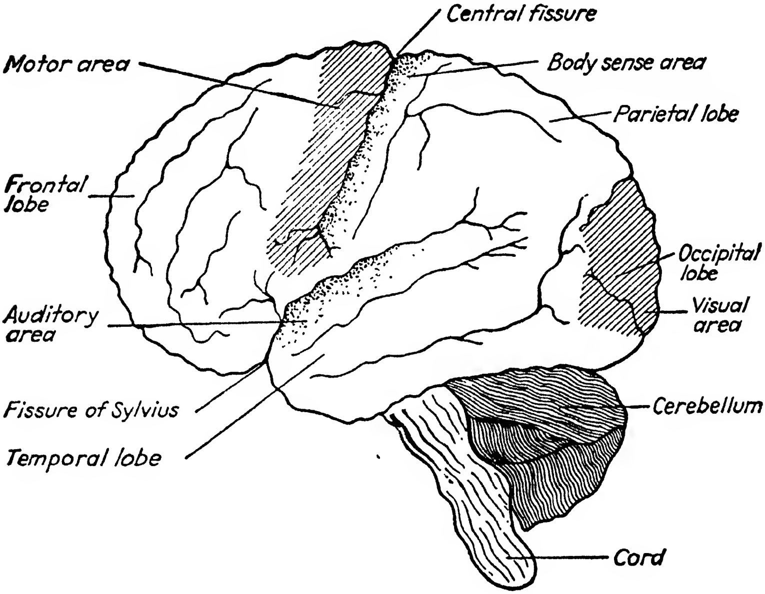

FIG. 55.—Side view of the brain showing functional areas. (*After Gates.*)

white matter or axons called the corpus callosum, which transmits messages from one hemisphere to the other. The hemispheres are divided into four areas or lobes, which are bounded by three fissures or folds in the surface of the brain. One of these, the central fissure, or the fissure of Rolando, divides the brain into a front part and a back part. The other, the fissure of Sylvius, passes backward and upward from a point nearly midway from

the base of the brain. The area lying just in front of the central fissure is the frontal lobe. The area just in back of the central fissure is the parietal lobe. The area at the extreme back of the cerebrum is the occipital lobe and is set off from the parietal lobe by the less easily observed parieto-occipital fissure. The area lying below the fissure of Sylvius is the temporal lobe.

Studies of the functions of the several parts of the brain, which began with the work of Broca, have shown that bodily sensations are normally located in the region posterior to the central fissure and that motor impulses are associated with the area anterior to the central fissure. The region for visual sensitivity is that of the occipital lobe, and the auditory area lies along the lower side of the fissure of Sylvius. Generalized areas for smell and taste lie on the under surface of the frontal lobes. The area of the bodily senses lies immediately back of the central fissure.

Aside from these rather generalized areas, no definite functions have been assigned to the various parts of the brain. An examination of Fig. 55 will show that large parts of the brain are thus without specific functions. These large areas are commonly called the association areas. The association areas of the frontal lobe have been shown to be normally related to the acquisition of new motor functions, whereas newly acquired sensory functions are more commonly related to the association areas of the other lobes.

The relation of white matter to gray matter in the cerebrum is just the reverse of that found in the spinal cord. In the cerebrum the gray matter forms a thin

outer layer about ⅛ inch in thickness. Wherever we find gray matter we know we are dealing with neuron cell-bodies and hence with the location of synaptic connections. In other words the synaptic connections are formed at the surface of the brain. The axons leading to and from the surface constitute the white matter that makes up the center of the brain. The term "cortex," which is often used to refer to the brain as a whole, is properly used to refer only to this outer layer of gray matter. The importance of the convolutions on the surface of the brain can be understood in this connection. The convolutions increase the total amount of surface area and hence the amount of gray matter. From this fact the idea has developed that intelligence may be judged in terms of the number and depths of the convolutions on the surface of the brain. It is possible that such relationships do exist as regards the brain of man considered in relationship to the brains of lower animals. As between individuals of the human species, however, no such connections can be drawn. This is because there are too many other variables influencing intelligence. Among these variables we may mention the thickness of the layer of gray matter, the density of the cell-bodies, and, most important of all, the quality of the neurons themselves.

The white matter in the center of the brain is made up, then, of relatively large bundles of axons leading from one point on the surface of the brain to another. These fibers are classified under three headings according to the route they follow: (1) association fibers. These fibers lead from one point to another on the surface

of the same hemisphere. (2) Projection fibers. These lead from the spinal cord up to a surface of the cortex or from the cortex outward to the spinal cord. (3) Commissural fibers. These fibers connect points on the surface of one hemisphere to points on the surface of the other hemisphere. They all pass from one hemisphere to another through the corpus callosum.

Work of Franz and Lashley on Cerebral Localization. A first consideration of these facts will lead the student to feel that, in part at least, the brain is segregated into portions, each of which is specialized to a given task. The studies carried out by Franz and Lashley were begun with this very belief. Professor Franz wished to trace through the brain the nerve pathways related to the various kinds of sensory and motor functions. His first studies were related to the influence of the destruction of the frontal lobes on the learning ability of cats. By destroying the frontal lobes of the animals under an anesthetic and in accordance with careful objective procedure, he was able to show that newly acquired habits were lost. This pointed to the concept of cerebral localization. It was observed, however, that older and more firmly established habits were not lost as a result of frontal lobe destruction and also that animals in whom the frontal lobe had been destroyed prior to the learning process could nevertheless learn habits nearly as well without the frontal lobes as they could with them. This point showed that although the frontal lobes may normally be associated with newly acquired habits they are not necessary to them and indeed that other parts of the brain can perform these functions

quite as well as does the frontal region. This shows that there is no specialized structure in the frontal lobe which is essential to the acquisition of these habits.

Professor Lashley, in continuing these studies, worked with white rats. He first duplicated Franz's experiments with the modification that he studied the influence of the destruction of the occipital lobe, which is the normal visual area, upon the visual discrimination habits of the rats. Here he found, as Franz had already done, that the destruction of the occipital lobes resulted in a loss of newly acquired visual habits but that it did not affect fully established habits. His work also proved that rats in which the occipital had been destroyed before learning visual habits could learn these habits quite as well without the occipital as they had with them. His further studies also showed that in the absence of the occipital, any convenient part of the brain can perform visual discrimination functions. His general conclusion was that impairment of function is proportional to the amount of the brain tissue destroyed but unrelated to the place of destruction.

The most recent work by Lashley and his coworkers tends to show that, although the brain does operate in terms of these large complex patterns rather than in specific pathways, there are certain limitations as to area of operation for some of these patterns. In the field of vision he has shown first that complete destruction of the striate areas does permanently abolish detailed vision, and second that there is no indication of any visual association areas apart from the striate areas. This may be taken to mean that in terms of the logic

of structure the animal brain has been specialized to a point where it is adaptable only within certain broad limits. Certainly in no case is there any evidence of the extreme degree of localization implied by such pseudo-scientific interpretations as those offered by phrenology.

Since the function of the frontal lobe is fundamentally motor and that of the other lobes is fundamentally sensory, it will be seen that an impulse coming into the brain must first pass to the cortex at one of its sensory parts, be communicated from there by means of association fibers to one of its motor parts, and from there out again over motor nerves to the spine. The slight amount of cerebral localization that has been observed is related to these points at which any given type of impulse happens to come to the surface. The important thing is that any given type of impulse utilizes a certain section of the brain, not because the nerves there are any different from nerves elsewhere, but because they constitute the most efficient route through the brain. It is because the nerves of all parts of the brain are fundamentally alike that the results found by Franz and Lashley are possible. It also explains why relatively vast destruction of brain tissue sometimes occurs without causing death or even in some cases a loss of consciousness. Striking cases of this have been recorded in medical history.

The American Crowbar Case as Reported in the Boston Medical and Surgical Record, 1848. In this famous medical case we have an instance in which the destruction of a large part of the brain failed to bring about any deep-seated disturbance in the mental life of the patient.

As a result of a premature blast, an iron crowbar 3½ feet long and 1¼ inches in diameter was driven through the head of a workman. The crowbar entered the head at the left side of the face, passed upward behind the left eye, and out through the foretop of the skull. Despite the fact that his ghastly injury destroyed the eye and a very large portion of the frontal lobe, the patient is stated to have retained his consciousness at all times. He was transported to a hotel a mile away from the scene of injury and walked unaided up a flight of stairs. Throughout the treatment of the wound and the period of recovery, the patient remained rational and made inquiries about the progress of the work and of the fate of his friends. The patient made a fairly rapid recovery and, aside from the loss of his eye, showed no harmful mental or bodily results of the injury.

The psychological implication of cases of this type is that since there is no high degree of specialization in brain functioning, it is possible that areas can be destroyed without upsetting basic patterns of habit. Probably in other cases in which the brain organization chanced to be somewhat different, an identical injury might have brought instant death. It is probable also that there are some portions of the brain in which functions are so narrowly determined by structure that injury inevitably results in some specific loss of function as that found by Lashley in his recent work on the relations of the striate areas to visual functions.

These vital experiments, together with others that have grown out of them, have definitely exploded the idea that the several parts of the brain are constructed

in such a way as to perform certain specialized functions. The slight amount of localization that has been noted may be thought of in terms of the most efficient routes through the brain. Here, as Professor Lashley has pointed out, we have evidence that the nervous system does not work in the manner of a telephone system through the operation of simple pathways to and from and through the brain, but rather that in every action the brain as a whole is active and that the response is controlled in terms of a complex pattern of impulses sent out over a network of motor neurons.

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Appendix B

PSYCHOLOGICAL EFFECTS OF VITAMIN DEFICIENCY

VITAMIN deficiencies, like glandular upsets, are of interest to psychologists primarily because of the way in which they affect emotional stability and balance and the efficiency with which one can perform one's duties. From these standpoints, two forms of vitamin deficiency are of especial psychological interest. They are deficiencies in vitamin A and vitamin B_1.

Vitamin A Deficiency. At the present time it seems pretty well established that night blindness is directly associated with vitamin A deficiency. Poor vision under conditions of low intensity of light is a critical matter in these times when so much night travel is done by automobile. There is some reason to believe that night blindness may also increase susceptibility to glare, possibly because the eye tends to compensate for the blindness by causing the pupil to be opened widely. Upon the approach of another car the bright light operates reflexly to reduce the pupil's size and thus drastically reduce what little ability at night vision the subject may have. Another life situation in which night blindness may be observed is extreme difficulty in adapting to vision in a darkened motion-picture theatre. A person with this vitamin deficiency may be quite unable to adjust to a

darkened room and, in the case of motion pictures, may even find it difficult to adjust to the vision of the screen itself. Borsook,[1] an outstanding authority, cites a case of extreme night blindness which was cured in 3 weeks by a proper change in diet and the administration of 30,000 units of vitamin A daily. Borsook believes that as many as 5 to 10 per cent of all automobile drivers may suffer from various degrees of night blindness.

There is some evidence that vitamin A deficiency may also be related to color blindness. In some instances in which color blindness appears or becomes more severe during the years, it has been possible to remedy the situation by proper vitamin A feeding.

Vitamin B Deficiency. Extreme deficiency in vitamin B_1 leads to a disorder commonly called beriberi or polyneuritis. In addition to the general weakened physical condition that is known to result from this vitamin deficiency we see that it has a specifically neuro-involvement. In other words, it is directly responsible for nervous upsets with profound psychological disturbances, which in some cases may be so severe as to cause death. In addition to the nerve irritation, which may take such forms as obscure neuritic and arthritic disturbances, this deficiency results in a chronic lack of stamina and extreme tendency toward fatigue. This alone will have an important effect upon the psychological efficiency of the patient. One of the worst effects of chronic alcoholism is also related to vitamin B_1 deficiency. This is the fact that the chronic alcoholic is undernourished in general. Borsook paints the following

[1] BORSOOK, H., *Vitamins*, The Viking Press, New York.

picture of the chronic alcoholic in interesting terms and in doing so points out the important psychological disturbances and the way in which they may be cured.[1]

The trouble with the chronic alcoholic is that his diet is like the traditional Kentucky breakfast—a bottle of whisky, a juicy steak, and a bulldog (the bulldog to eat the steak). The chronic alcoholic lives, typically, on a diet of whisky, coffee, and sandwiches. He suffers from undernutrition and malnutrition. After a certain time on this regime he comes down with severe neuritis, in which there may be not only pain but also wrist-drop and failing spinal reflexes. He can be quickly relieved by thiamine, even when his consumption of alcohol is increased. But if he wishes to be really cured he needs nourishment of every category and psychological treatment.

Other Vitamin B Deficiencies. Vitamin B_2 deficiency is closely related to irritability of certain skin tissues and especially to eye troubles even to the extent of causing cataracts and other forms of failing vision. In some instances where a tendency toward night blindness did not respond to vitamin A treatment, it has been relieved promptly by means of vitamin B_2.

Nicotinic acid constitutes a part of the vitamin B complex. A deficiency of this element leads to pellagra, which is fairly widespread among the poorer parts of the United States, especially the South. Pellagra results in the typical picture of indolence and slovenliness, which has been caricatured in popular cartoons referring to the hillbilly. Actually the effects of pellagra are much more grave, since it accounts for a large part, perhaps 10 per cent, of all the insanity that occurs in areas where pellagra is prevalent. In addition nicotinic-acid defi-

[1] BORSOOK, H., *Vitamins*, p. 61.

ciency may be a direct cause of delirium tremens. This disorder can often be cured in 1 or 2 days by the administration of nicotinic acid. In general, we are beginning to accumulate evidence that the B-complex deficiency is associated with premature old age, probably causing, among other things, a degeneration of the adrenal glands, the function of which is studied in another section of this book. The foregoing notes are sufficient to indicate that the psychological effects of vitamin deficiency are very great. The economic losses and personal adjustments growing out of these deficiencies are especially tragic in view of the fact that adequate vitamin feeding could be accomplished very easily and at remarkably small cost.

The effects of vitamin deficiency have been strikingly apparent in the countries ravaged by the Second World War, as they have probably been in conjunction with most wars. We are told that Spain, particularly, suffered terrible hardships from vitamin deficiencies, especially the B group. Infant mortality reached an alarming figure and beriberi and pellagra were rampant. It is to be noted that low-quality diets such as prevail during wartime are particularly bad because of their vitamin deficiency. A very small amount of vitamins fed to the people of Spain in the post-Civil War period might have prevented most of the tragic results even though the rest of the diet remained as bad as it was. There is much evidence that Germany, usually systematic in matters relating to efficiency, is nevertheless allowing a condition of chronic vitamin deficiency to affect her own people and, we may be sure, even more completely, the

peoples of her subject countries. On the other hand, one would perhaps be inclined to discount or to require further evidence before believing the propaganda stories that are currently circulating to the effect that Germany is depriving her subject peoples of vitamins so as to reduce their vitality and hence their capacity to cause trouble. It would seem more reasonable to suppose that these conditions are the result of the upset of distribution facilities and to an ignorance regarding vitamins, which is, presumably, at least as great in European countries as it has been in America.

SUGGESTED READINGS

BORSOOK, H.: *Vitamins.*

Appendix C

GLOSSARY OF PSYCHOLOGICAL TERMS

ability: a capacity to do something.
abnormal: wide departure from the norm.
action current: an electrical current.
acuity: ability to distinguish stimuli.
adaptive behavior: behavior appropriate to the situation.
adjustment: process of becoming more favorably related to the environment.
affective state: any emotional or feeling experience.
afferent: conduction toward the central nervous system.
ambivert: not predominantly introvert or extrovert.
amentia: congenital lack of mental power.
analgesia: insensibility to pain.
anthropology: science of man.
aphasia: inability to speak or to understand words.
apperception: focused perception.
assimilation: fusion of new with old experiences.
atrophy: reduction or disintegration of an organ.
attention: narrowing of the range of objects responded to by the organism.
attitude: persisting tendency to respond to a given stimulus in a given way.
auditory: pertaining to the sense of hearing.
automatograph: machine that records involuntary movements.
autonomic: self-regulating.
autosuggestion: giving oneself suggestions regarding action or one's physical condition.
average deviation: average amount of difference between individual scores and the mean of the group.

bi-modal: distribution curve with two peaks.

central tendency: any typical value.
cerebellum: a major division of the brain related especially to muscular coordination.
cerebrum: upper portion of the brain associated especially with voluntary action.
characterological: an attempt to obtain a total view of personality; a Gestalt application in modern German military psychology.
chronometer: time-measuring mechanism.
chronoscope: an instrument for measuring very short time intervals.
clairvoyance: alleged supernatural power of perception.
compensation: substituting a desirable trait for an undesirable one.
compulsion: the performance of an act that is contrary to the inclination of the performer.
conditioned response: a response that has come to be aroused by a new stimulus.
configuration: any organized whole, the parts of which are inseparable.
congenital: existing in the individual at birth.
consciousness: awareness.
constitutional temperament: inherited affective tendencies.
contiguity: nearness of two or more objects.
contraction: shortening of a muscle.
coordination: harmonious combination of muscular movements.
corpus callosum: band of nerve fibers that connects the two cerebral hemispheres.
correlation: a relation between two objects in which a change in one is accompanied by changes in the others.
cortex: the outer layer of an organ (brain).
criterion: a standard for comparison.

deduction: reasoning that advances from general propositions to specific conclusions.
degeneration: change from better to worse.
dementia: loss of mental powers.
dendrite: the part of a neuron that transmits impulses toward the cell-body.

dexterity: skill or expertness.
dorsal: pertaining to the back.
drive: any intraorganic activity or condition that supplies stimulation for a particular type of behavior.
dynamic: pertaining to the causes and effects of mental behavior.
dynamometer: instrument that measures muscular strength.

effector: organ that responds to stimuli.
efferent: leading out from (example: motor nerve leading out from spinal cord).
eidetic imagery: exceedingly vivid imagery.
emotion: an experience accompanied by a strong degree of feeling.
empirical: pertaining to conclusions based on experimental observations.
end brush: finely branched termination of an axon.
ergograph: an instrument for measuring and recording the work done by a single muscle or by a set of muscles.
erogenous: certain sensitive regions of the body where stimuli (especially tactile and temperature) initiate sexual feelings.
eugenics: science of heredity.
excitation: the effect of stimuli on nerves.
exhibitionism: a tendency (usually compulsive) to display a sexual part of the body.
explicit: overt, a response that may be easily observed.
extroversion: preoccupation with external things rather than oneself.

fatigue: an inability (of a muscle) to perform work, which may be overcome by rest.
filial: pertaining to offspring.
fissure: a deep furrow in the surface of the brain.
fixation: 1. strengthening an acquired tendency. 2. focusing the eyes upon some object.
flaccid: flabby; weak.
fovea: the area of sharpest vision on the retina.
fraternal twins: the result of the simultaneous growth of two zygotes.
frustrate: to defeat or thwart.
function: the use to which a structure is put.

functional psychology: a psychological position that defines mental phenomena as acts rather than as experiences.

galvanometer: instrument measuring the strength of small electric currents.

ganglion: a cluster of nerve cells.

generalization: process of forming a judgment relating to a class of data.

genetics: science of heredity, variation, and evolution.

Gestalt: an integration of members; configuration; a school of psychological thought.

gregariousness: tendency to live in groups.

habits: customary way of action.

halo effect: tendency, when rating a trait, to be influenced by some other trait.

heredity: transmission of traits from parents to offspring.

homosexuality: sexual attractions on the part of an individual for individuals of the same sex.

hormone: internal secretion usually from an endocrine gland.

hypnosis: artificially induced state of extreme suggestibility.

hypothesis: a preliminary assumption.

hysteria: nervous and mental disorder.

illusion: mistaken perception.

implicit: a response not easily observable by another person.

induction: reasoning from the particular to the general.

inhibition: restraining a process.

innate: inborn.

insight: direct acquisition of knowledge without the usual learning process; stressed in Gestalt psychology.

insomnia: chronic inability to sleep.

instinct: a fairly complex and unlearned action.

integration: unification of parts into a whole.

intelligence: ability to meet new situations successfully by adaptation.

interjectional theory: theory that speech has arisen from automatic utterances.

introspection: the subjective observation of one's own mental processes.
introversion: preoccupation with oneself.
intuition: direct or immediate knowledge.
irritant: used in psychology to refer to any stimulus object.

kinesthetic sense: sense that yields knowledge of the movements of the body or its members.
kleptomania: an irresistible tendency to steal.
kymograph: (usually) a drum carrying smoked paper for recording physiological processes.

larynx: the part of the windpipe that contains the vocal cords.
law of filial regression: offspring tend toward the average type.
learning: acquiring the ability to respond adequately to a situation.
libido: sexual desire or energy.

maladjustment: inability to adapt one's behavior to the conditions of his environment.
manipulation: activity limited to local movement, *i.e.*, the hands.
masochism: perversion characterized by deriving sexual satisfaction from being physically abused.
masturbation: sexual self-stimulation.
maturation: growth and development.
maze: network of paths.
median: the middle score.
medullated: covered by a myelin sheath.
memory: capacity for reviving past experiences; recollection.
metabolism: process of building up and breaking down body tissues.
metronome: instrument that marks off short periods of time by sharp sounds.
mid-parent: the average of the two parents.
mode: the most common value in a series.
mono-modal curve: distribution curve with one peak.
motivate: provide an incentive.
motor: muscular and glandular activity.

narcissism: self-love.
negative response: response directed away from the stimulus.
neural arc: connected series of neurons from receptor to effector.
neurasthenia: abnormal fatigability.
neurology: study of the structure and function of nerves.
neuron: a single complete nerve cell.
neurosis: disorder of nervous system with no observable physical basis.
norm: standard value for a group.

objective: physical, recordable by instruments.
obsession: irresistible idea or urge.
occipital: pertaining to the back of the head.
olfactory: pertaining to smell.
onomatopoetic theory of language: language started by imitation of sounds in nature.
organic: pertinent to structure pertaining to or consisting of an organ or organs.
orientation: knowledge of who and where one is.
overt: movement that can be easily observed.

paramecium: a single-celled animal.
paresis: general paralysis of the insane due to syphilis.
parsimony: "the simpler of two hypotheses is the preferred."
patellar reflex: knee-jerk reflex.
pathology: study of abnormalities and disease.
pedagogy: theory and art of teaching.
perception: awareness of objects or data.
periphery: outside of an organ.
peristalsis: wavelike contraction as of organs of the alimentary canal.
permutation: one of the possible arrangements of the items in a group.
personality: the general character, or pattern, of an individual's behavior.
phallic: symbols representing the male sex organs.
phenomenon: any fact that can be observed.
phrenology: false belief that mental traits can be judged by the bumps on the skull.

physiognomy: judging mental traits from physical appearance.
pictograph: pictorial representation of an idea or event.
pitch: character of a tone, as high or low.
pituitary gland: endocrine gland at the base of the brain.
plateau: temporary halt in the progress of learning.
polygraph: apparatus that measures and records several physiological functions simultaneously.
posture: an adjustment of the body, which facilitates some action.
prejudices: opinion, usually unfavorable, formed without just reason.
prognosis: prediction of the duration, course, and outcome of a disorder.
proprioceptor: sense organ located within bodily tissue.
protoplasm: living substance.
pseudo-: false; pretended; counterfeit.
pseudoscope: instrument that brings the left side of an object to the right eye and vice versa.
psychiatry: the study of mental disorders.
psychogalvanometer: an instrument used to measure the galvanic skin response.
psychograph: chart used to indicate personality traits.
psychology: science of mental operations or of the behavior of the organism.
psychoneurosis: neurosis that requires psychotherapy.
psychosis: an abnormal mental condition.
puberty: period of life at which physical womanhood and manhood begins; sexual maturity.
pubescence: arriving at or just reaching puberty.
pupillary reflex: change in the size of the pupil of the eye.
pursuitmeter: instrument for measuring eye-hand coordination.
pyromania: uncontrollable desire to set fires.

rationalization: plausible but not correct reasons (for failures).
reaction: movement or other bodily effect resulting from stimulation.
reason: logical thinking.
receptor: sense organ.
reflex: a simple unlearned act.

refractory phase: period following the stimulation of a nerve during which it is inexcitable.

resonance: the vibratory response of a body to a frequency imposed upon it.

response: reaction.

retention: persistent aftereffect of an experience.

retina: receptor for vision.

retrospection: mentally reviewing past experiences.

saccadic movement: jerky movement of the eyes in reading.

sadism: perversion in which the individual takes pleasure in inflicting pain on one of the opposite sex.

satisfier: stimulus that fulfills desires.

science: organized knowledge.

semantics: scientific study of the history and evolution of the meaning of words.

senescence: becoming senile, old.

sensation: experience aroused from outside the nervous system.

sensorimotor: pertaining to neural activity.

sensory nerve: carries impulses from sense organs to cell body.

sexual perversion: abnormal sexual desire or manner of gratification.

sibling: a sister or brother.

sigma: $1/1000$ second.

smooth muscle: muscles activated chiefly by the autonomic nervous system.

spasm: convulsive involuntary contraction of muscle.

standard deviation: a measure of variability.

statistics: branch of mathematics that evaluates data.

stimulus: anything that excites a receptor.

striped muscles: skeletal muscles.

stylus: pencil-like device used for tracing a line, as on a kymograph.

subjective: observations without aid of measuring instruments.

sublimation: the transfer of sexual energy into other forms of creative or social interests.

submissiveness: behavior characterized by the tendency to yield.

summation: repetition of stimuli.

symbol: a stimulus or response that acts as a substitute for another.
synapse: the point of junction of two neurons.

tachistoscope: instrument that gives very brief exposure to visual stimuli.
tactual: pertaining to the sense of touch.
telepathy: communication of ideas from one mind to another without the aid of sense organs.
temperament: typical character of one's emotional responses.
tetanus: continued contraction of a muscle.
thalamus: mass of gray matter in the mid-brain.
theory: a formula for explaining a phenomenon.
tic: uncontrolled nervous twitching.
tonus: partial contraction of a muscle.
trait: a distinctive mode of behavior.

urge: a strong tendency to perform a certain act; a strong motive, usually not definitely conscious.

validity: extent to which a test measures the trait intended.
variable: quantity that may increase or decrease.
ventral: pertaining to the abdominal side of the body.
vocal: pertaining to speech.
voluntary: under control of the will.
voyeurism: a person who obtains sexual gratification from observing sexual actions or parts.

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